Light and Lighting

Vol. XLV.—No. 7. July, 1952 One Shilling and Sixpence

Contents

Published monthly by the Illuminating Engineering Publishing Co., Ltd., at 32, Victoria St., London, S.W.1. Telephone ABBey 7553. Subscription rate £1 per annum.

The official journal of the Illuminating Engineering Society.

Summer Meetings

MANY of our pages this month are devoted to accounts of the third Summer Meeting of the I.E.S. which took place recently in Eastbourne, and of the similar meeting of the corresponding French Society which preceded it at Toulouse. Each of these meetings was attended by members of both Societies, so that each afforded opportunities for informal bi-national discussions upon lighting topics. At the I.E.S. meeting there were also visitors from the United States, Holland, Denmark, France and Eire, and papers were presented by a visitor from each of the first two of these countries. The I.E.S. meeting was undoubtedly a great success as a domestic affair, but the presence of visitors from several other countries was not only a happy event in itself and a testimony to the growing popularity of these meetings, but it suggests that such meetings may be used with advantage to bridge the gap between meetings of the International Commission on Illumination by means of personal interchanges of views and interim unofficial progress reports.

Notes and News

I.E.S. Summer Meeting

A detailed account of the I.E.S. Summer Meeting is given in this issue, so we will curb our enthusiasm, which we think is shared by everyone who was present at Eastbourne, and confine ourselves in this column to just a few comments.

The subject of "brightness engineering" as the underlying theme of the papers proved an excellent choice, and it was clearly evident from the attendance at the technical sessions and from the attention which speakers were given that the subject is of great interest to the practising lighting engineer.

The problem of visual comfort is now being studied in a number of countries, and the presence at Eastbourne of several of the leading workers in this field led to discussions, both at the meetings and informally, which might well lead to some closer degree of international co-operation which is now so obviously required. Dr. Hopkinson, who has already been active in urging such co-operation, asked in the discussion on Mr. Logan's paper whether those who had studied this problem were now able to get together to draw up an internationally agreed set of tables for the use of the practising lighting engineer who might get tired of waiting if the experts continued much longer in their search for perfection before applying their results to practical use. This expression will, no doubt, find ready support, particularly, we feel sure, from Mr. Brentwood, of Melbourne, Australia.

It would be an exaggeration, unfortunately, to say that the architectural profession took any great notice of the summer meeting, but interest was added to the final day by the contributions to discussions by Mr. Mark Hartland Thomas, of the Council of Industrial Design, and by Mr. Cooke-Yarborough, both architects of some standing in their profession. There was an exchange of views between lighting engineers and these architects, and, of course, with Anthony Pott, which we thought most encouraging. We hope there will be further meetings at which lighting engineers and architects will talk equally frankly.

Finally, in his dinner speech, the president, Mr. Holmes, referred to the long-awaited report on office lighting, the drafting of which was completed three years ago.

Mr. Holmes will probably be more pleased than we are that a copy of the published report has appeared on our desk this morning just as we are about to go to press, so that we have had to reset the remainder of these two pages to include a note on it.

Office Lighting

"The Lighting of Office Buildings," No. 30 in the Ministry of Works Post-War Building Studies, is a report by the Lighting Committee of Building Research Board, Department of Scientific and Industrial Research, on the daylighting and artificial lighting of offices. It follows an earlier report by the same committee (Post-War Building Studies No. 12) which dealt with the general principles of lighting and their application to dwellings and schools.

The report recommends (1) For natural lighting: A sky factor of 1 per cent. at a point not less than 12 ft. inwards from the outer face of the wall, with a minimum sky factor of 5 per cent. for drawing offices. A method of determining standards is described. (2) For artificial lighting: Values of the order of 20 lm./ft.^{2} for book-keeping, typing, computing machine work, filing and general office work; for drawing

* "The Lighting of Office Buildings," Post-War Building Studies No. 30. H.M.S.O., price 3s. 6d.

offices, 30-50 lm./ft.^{2}; for private offices, 15 lm./ft.^{2}; for inquiry and reception rooms, crush and entrance halls, 6 lm./ft^2. It is noted, however, that persons over forty may require higher values because "especially from the fourth decade onwards, the illumination level necessary to facilitate close work rises progressively."

We hope to deal more fully with the report in a subsequent issue.

Colour Television

A symposium of three papers on the very topical subject of "Visual Problems in Colour Television" was arranged by the Colour Group of the Physical Society for its meeting held on May 14 at the Royal College of Science.

The first speaker was Mr. R. G. Horner, who gave an excellent general description of the different ways in which a picture could be presented to the eye by means of a spot scanning a given area. He referred to the various schemes of interlace adopted in producing 60 complete pictures per second and to the necessity for keeping the bandwidth in the frequency spectrum as narrow as possible. A coloured picture could be transmitted by presenting to the eye in rapid succession a sequence of three complete pictures, one in each of the three colour primaries used, or the picture could consist of triplets of lines, one for each colour, or, finally, it could be made up of coloured dots, as in the additive system of colour photography.

The eye, said Mr. Horner, was less sensitive to contrast in colour than in monochrome, so that bandwidth could be conserved by reducing the definition of the coloured pictures. It had been found, in fact, that very inferior definition could be tolerated provided a sharp picture in black and white were superimposed at the same time. This was possible by using a special arrangement of the circuit, giving what was known to television engineers as "mixed highs."

The extent to which lack of definition could pass unnoticed under these conditions was very clearly demonstrated. Three component pictures in colour were deliberately put badly out of focus so that by themselves they were quite unacceptable, but the addition of a sharp monochrome component made the final picture appear quite in focus.

The second speaker was Mr. L. C. Jesty, who described certain problems still awaiting solution, e.g., flicker and colour break-up in field sequential scanning and, in dot sequential scanning, flicker of detail and stroboscopic effects. Then there were certain unresolved questions as regards the demands of the viewer. For example, he asked, would the addition of colour permit a degradation of picture sharpness, or would the closer approach to realism demand equal or even improved detail in the picture? Finally, he said, who should make the final assessment of any particular quality? Should it be experts, or a team of "average observers?"

The last speaker was Prof. W. D. Wright, who had just returned from the United States, and who gave a brief description of some of the work he had seen in progress there, of the difficulties which had been encountered and of the methods of overcoming them which were being tried. He said that the use of the C.I.E. colour data needed reconsideration because these applied to a 2-deg. field, and they might have to be modified somewhat to apply to the much larger field of the television screen.

C.I.E. Proceedings, 1951

Copies of the proceedings of the International Commission on Illumination meeting, held in Stockholm last year, may now be obtained from Mr. L. H. McDermott, hon. secretary of the National Illumination Committee at the National Physical Society, Teddington, Middlesex. The proceedings are in three volumes; Vol. 1 (Secretariat Reports), Vol. 2 (Papers presented at Stockholm), and Vol. 3 (Reports of the Sessions). The price of Vols. 1 and 2 is £2 per volume and that of Vol. 3 is 17s. 6d.

Floodlighting of the Basilique St. Sernin at Toulouse during the annual conference of the Association Française des Eclairagistes.

I.E.S. Summer Meeting at Eastbourne

The Eastbourne meeting of the I.E.S. more than maintained the reputation which these biennial meetings have acquired since the first was held in 1948. The following is a detailed report on the meeting.

The third biennial summer meeting of the Illuminating Engineering Society took place at Eastbourne under the presidency of Mr. J. G. Holmes from May 20 to 23. The ideal weather, excellent lecture theatre facilities, smooth organisation and first-class papers resulted in an extremely happy meeting; those who had been present at the previous meetings voted the Eastbourne meeting as the best so far.

Some 340 members and visitors registered for the meeting, including members from nearly every Centre and Group of the Society. A warm welcome was given to a number of visitors from overseas, including Mr. Henri Maisonneuve, Mr. Jean Chappat, Mr. Jean Maisonneuve, and Mr. and Mrs. Rene Nampon, from Paris, Mr. and Mrs. H. L. Logan, and Mr. and Mrs. E. C. Hugh, of New York, Mr. L. C. Kalff and Mr. Joh. Jansen, of Eindhoven, and Mr. and Mrs. B. Knudsen, of Copenhagen.

On the Tuesday evening delegates were entertained by the Mayor and Mayoress of Eastbourne (Alderman and Mrs. Croft) at a Civic Reception. The entertainment and hospitality given to the Society were of a very high order, which, together with the outstanding personality of Alderman Croft, ensured the success of the evening and laid a good foundation for the whole of the meeting.

The following morning delegates witnessed a perfect example of how a conference should be opened when, in truly brilliant style, Alderman Croft officially welcomed the Society to Eastbourne. In replying, the President paid tribute to the help and co-operation which had been given by the officers of the Corporation in arranging the meeting, and said that though this opening ceremony was the last public duty of Alderman Croft as Mayor, an office which he was to relinquish that same morning, delegates to the meeting were looking forward to seeing him and Mrs. Croft, together with their successors, at the Society's dinner to be held on the Thursday evening.

During the morning the ladies joined Mrs. J. G. Holmes for coffee at the Devonshire Lawns Restaurant. Another special arrangement for the ladies was a visit to Battle Abbey on the last afternoon of the meeting.

The Physiology of Brightness

After the opening ceremony, the President remained in the chair for the first technical session, at which Dr. W. S. Stiles presented his paper on "The Eye, Brightness and Illuminating Engineering." As he pointed out, and as subsequent speakers emphasised, the great interest which lighting engineers everywhere are now showing in the subject of brightness makes it very desirable to review the basic facts which are known about this phenomenon, and particularly to examine the properties of the eye to find out whether they indicate any desirable limitations on brightness or brightness ratios in the field of view.

Dr. Stiles stressed the importance of retinal illumination, and discussed the relationship between this and the luminance of the objects viewed. There were several factors to be taken into account here, viz., the size of the pupil, the position of the object in the visual field, the effect of astigmatism in spreading the light over a considerably larger area than that of the geometrical image, absorption in the eye media, and the effect of scattering in these media and in the retina itself. Finally there was the reduction suffered by rays entering the eye near the periphery of the pupil, the effect which Dr. Stiles himself discovered in collaboration with his

Alderman and Mrs. J. Croft, Mayor and Mayoress of Eastbourne, who gave a warm welcome to the I.E.S.

colleague Dr. Crawford (although this fact was not mentioned).

Next Dr. Stiles went on to discuss the effect of the colour of the light. As he pointed out, the C.I.E. values for the relative luminous efficiency of radiation, $V\lambda$, the values on which our calculations of the relative effectiveness of light of different colours are generally based, apply in strictness only to that part of the retina which is responsible for most distinct vision (the fovea) and when the general brightness level is high; quite other values apply to the rods which are entirely responsible for vision at very low brightnesses and which are to be found in ever-increasing numbers, compared with the cones, in the non-central and peripheral parts of the retina. He mentioned that it had been definitely established that visual acuity was somewhat higher by the monochromatic light of the sodium lamp than by the light of a tungsten filament lamp.

Next came a very interesting part of the paper in which the glare due to excessive brightness was discussed. The glare from a bright area was frequently due, not so much to the absolute value of the brightness, as to the high brightness of one part of the visual field in comparison with that of the remainder, or sometimes in comparison with the brightness level to which the eye had previously been adapted. There was some

Delegates returning from the opening session. Left, Mr. S. S. Beggs (G.E.C.), M. Jean Chappat (Compagnie des Lampes, Paris) and the President; Right, Mr. Hugh White and Dr. R. C. G. Williams (Philips Electrical) and Mr. H. G. Campbell (Benjamin).

At the Ladies' Reception. Left, Mrs. Olsen, Mrs. Widnall and Mrs. Harper. Right, Mrs. Sawyer, Mrs. Boydell, Mrs. Hubble, Mrs. Knudsen and Mrs. Atkinson.

evidence, said Dr. Stiles, that as the brightness of the field of view was raised from very low to very high values, the visual process underwent a radical modification in a region corresponding to the retinal illumination produced when an extended field with a luminance of between 1,000 and 2,000 ft.-lamberts was viewed through the natural pupil. There was also the interesting phenomenon of the "dancing dots" which occurred with blue or violet light at a much lower value of luminance (of the order of 1 ft.-lambert). Small bright dots appeared suddenly in the field of view, moved on a rapid irregular course of a few degrees in length and then disappeared; they never encroached on a central area of the field corresponding approximately to the foveal region.

Inter-action and Glare

In the concluding sections of his paper Dr. Stiles discussed the effect of light in one part of the visual field on ease of vision in another part. He said that such inter-action might be due to a number of very different causes, including (a) the purely physical processes of light scattering, etc., which led to a retinal illumination outside the actual image of the disturbing light (b) the inter-action in the multi-layer network of nerve cells contained in the retina (c) the inter-action at higher levels of nerve activity in the brain. There was also the possibility of (d) the diffusion of photo-sensitive substances from one part of the retina to another, resulting in reduced concentrations in the neighbourhood of a region of intense stimulation.

A number of investigators, said the

Mr. John Christie talking to the visitors at Glyndebourne.

Dr. Wellwood Ferguson (President-elect) and Mrs. Ferguson discussing costume with Mr. Christie.

author, had studied the effect of an intense light source on vision at another part of the field. It had been shown, for example, that the reduction of the apparent brightness of the field due to the presence of a very bright source depends on the value of $B\omega/\theta$ where B was the luminance of the source, ω the solid angle it subtended at the eye and θ its angular distance from the region of attention. Other investigators found that such a source caused a reduction in ease of vision which was equivalent to that which would be brought about by interposing a veiling luminance proportional to $B\omega/\theta^2$ between the eye and the object viewed.

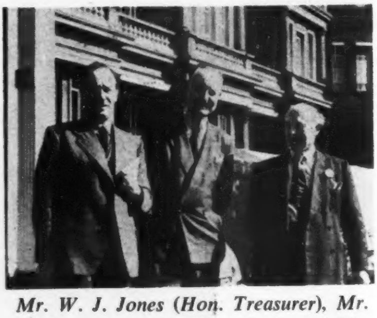
Finally there was the accepted fact that glare situations in which the measurable effect on vision was nil or very slight might nevertheless be most uncomfortable and might, in the long run, reduce the general efficiency and well-being of the individual. This had led to the development of the "jury method" of assessing discomfort according to a scale of successive steps of severity. This was the method used by Petherbridge and Hopkinson in their work reported to the Society about two-and-a-half years ago. In conclusion, Dr. Stiles said that in specifying requirements for comfortable lighting, brightness could not be considered alone; other factors had to be taken into account, especially the illumination at the eye. He gave a strong hint, in fact, that rough justice might be done by using for glare assessment the simple expression $E(B_s/B)$ where E was the illumination at the eye, B_s the luminance of the sources within an angular distance of 50 deg. and B the luminance of the field of view in general. It is more than possible that this hint will be followed up by workers in this field of illumination research either here or in America, particularly as Mr. W. Robinson, during the discussion, mentioned that he had independently arrived at the same simplification in his work of introducing engineers to the concept of glare factors.

The discussion was opened by Mr. H. C. Weston who recalled that at the first technical meeting of the Society, over 40 years ago, Sir John Parsons had discussed the subject of brightness in his paper on glare. Further, Prof. Weber had laid down rules for the avoidance of glare which, it was interesting to note, were very similar to those in use to-day.

Mr. S. S. Beggs urged that much more attention should be paid to fundamentals, such as had been discussed in the paper, instead of to the development of a number of apparently unrelated rules. He thought that the figure given by Dr. Stiles for the upper limit of the Purkinje range, viz., 3 ft.-lamberts, seemed very high. He asked if there was any evidence of an increase in visual acuity under monochromatic lights other than sodium.

Dr. R. G. Hopkinson said that recent work at the Building Research Station had shown that such "distortions" as Dr. Stiles had made in the glare formula with the object of simplifying it were quite legitimate, having regard to the differences between the results obtained by different workers and the variations found among observers. He said that in his experience colour vision seemed to improve with increase in illumination up to very high levels.

Dr. R. C. G. Williams asked whether the difference in the relation of visual acuity to



Mr. W. J. Jones (Hon. Treasurer), Mr. E. C. Lennox (Vice-President) and Mr. H. C. Weston (Hon. Secretary).

illumination for sodium and for tungsten light had any connection with the principle known to television engineers as "mixed highs," in which very inferior definition in the colour pictures shown could be made quite satisfactory to the viewer if a sharp monochromatic picture was superimposed.

In his reply Dr. Stiles said that there was definite evidence that visual acuity increased with brightness up to very high values, but that the evidence regarding any improvement of visual acuity with monochromatic light was inconclusive except in the case of sodium. He pointed out that the Purkinje range varied greatly with the retinal area considered. In reply to a question from Mr. Hime he said that the effect of macular pigmentation was greater in the case of Egyptian subjects than for Europeans.

Dr. S. English (Joint Managing Director, Holophane, Ltd.) with Mr. H. L. Logan (Holophane, New York), the President, and Mr. W. T. F. Souter (Sales Director, Holophane, Ltd.).

"Two Frontiers of the Lighting Art"

Mr. H. L. Logan's paper with this title was presented at the afternoon session on Wednesday under the chairmanship of Dr. Wellwood Ferguson. It was a complete contrast to the morning paper by Dr. Stiles, for Mr. Logan took as his starting point a study of the distribution of light in natural fields of view. Man, he said, had his origins in certain areas mainly situated along the isotherm corresponding to an annual average temperature of 70 deg. F. A careful survey was, therefore, made of the distribution of brightness in the open landscape at two localities in the United States on that isotherm. Then the normal field of view of a pair of human eyes was divided into eight zones, viz., an upper and lower glare zone, defined as the areas within 30 deg. of the line of vision, respectively above and below the horizontal plane, then upper and lower binocular zones, defined as those areas outside the glare zones over which vision was normally binocular, and finally the more or less peripheral zones over which vision was normally monocular.

The light flux from each zone was measured with a specially designed instrument, and from a study of the figures obtained it was possible to lay down upper and lower limits for the proportion of the total light coming from each of these zones. These maxima and minima were, for convenience, plotted on a chart, and the next step was to devise means by which the light distribution from any proposed lighting scheme could be plotted on this chart.

Mr. Logan then explained the use of a projection web which, used in conjunction with a plan and elevation of a room and supplemented with other necessary data, enabled a complete perspective drawing to be prepared for a particular room and for any selected position of the observer. On this drawing the values of luminance were marked on each of the areas coming within the observer's field of view. The lines dividing the field into the eight zones described above were also marked on the drawing and thus it was possible to arrive at a figure proportional to the light which reached the observer's eye from each of these zones. The total light reaching the observer's eye was in this way apportioned among the eight zones and the corresponding percentages could be plotted on Mr. Logan's diagram of maxima and minima for comfortable seeing.

Both the written description and Mr. Logan's account of the method gave the

impression that it was somewhat laborious and complicated but, as with all such computations, once the routine is understood and provided full use is made of the aids furnished in the form of charts and tabular sheets, the work can be carried out quite rapidly and with no further equipment than a slide-rule and, if possible, a planimeter.

Mr. Logan gave an example of the way in which the method could be used to check a proposed system of lighting and decoration. When the analysis was applied to a certain office installation it was found that the proportion of light from the upper monocular

The President (Mr. J. G. Holmes) and Mrs. Holmes.

zone was considerably above the maximum recommended, while in all the lower zones it was practically on the minimum. This disproportion was corrected by increasing the reflection factor of the floor from 10 to 30 per cent. and of the desks from 10 to 40 per cent., with a few minor alterations elsewhere. A very much better distribution of light was thus achieved without any additional lighting equipment.

The adoption of the author's method naturally meant that the illuminating engineer had to have a large say in the choice of the decoration, and Mr. Logan described a statistical study of personal reactions to different colours. Those greatly liked and those definitely disliked were both rejected for use in general work surrounds, on the ground that a neutral emotional response was desirable. As Mr. Logan put it, the remaining colours "do not engage any of the energy of the workers in the energy-draining channels of emotional responses."

Glare Factors and Visual Comfort

The second half of the paper, to which Mr. Logan did not refer in his presentation at the meeting, was devoted to a discussion of the present position regarding the assessment of the degree of visual comfort in an installation. The work of Harrison, of Luckiesh and Guth, of Petherbridge and Hopkinson, and of other workers in this field was analysed, and from a critical combination of their results the author produced a diagram described as a "visual comfort chart." In this the abscissae were values of the size of a light source, expressed as a percentage of the total visual field, while the ordinates were values of luminance of the source. A family of curves gave the relation between these two quantities for the borderline between visual comfort and discomfort when the general level of adaptation of the eye had the value marked on any particular curve.

A suggested method of finding the combined effect of a number of sources was described. The "position indices" of Luckiesh and Guth were plotted to give a series of curves superimposed on the perspective protractor used for the work described earlier. Thus the position index for each source in the observer's field of view could be obtained at once by inspection. The actual luminance of any source, divided by the position index, gave the equivalent luminance of a source of the same size in the line of vision. From the visual comfort chart, this equivalent luminance could be transformed into the equivalent area of a source of some arbitrarily selected luminance. By this process the actual array of sources could be transformed into an array of sources of different sizes, all on the line of vision and all having the same luminance. The sum of these areas could then be used to determine the total effect of the original array of sources.

Opening the discussion, Dr. Hopkinson said that Mr. Logan had put forward an original idea as to what constituted good lighting and he wondered whether, in fact, the conditions which suited primitive man, a hunter and nomad, would be best for present-day man working indoors. He thought that the fundamental concept of what made for

The President greeting the Astronomer Royal, Sir Harold Spencer Jones, and Lady Jones at the Grand Hotel.

visual comfort was different on the two sides of the Atlantic. The American concept he would define as a "benign neutrality," but over here we did not consider that comfort was synonymous with absence of discomfort; it called for other things as well, such as sparkle and vitality.

Mr. W. Robinson asked if there was any critical level of illumination at which the principles described by Mr. Logan were applicable or whether they could be used quite generally. He wondered how the author managed to get such a free hand with his schemes of decoration.

Mr. W. Imrie-Smith remarked that, according to the author, a straight line at the "unity" level on his diagram would indicate a satisfactory installation, yet this would correspond to an environment of uniform brightness, such as would be found inside an integrating sphere and, he said, this was certainly not his idea of comfort. He felt that probably the ideal to aim at was a line about midway between the maxima and minima recommended.

Mr. S. Anderson wondered whether the author was wise in rejecting, not only the colours generally disliked, but also those generally regarded with favour. This was to limit the choice severely and there was the further complication of the effect of different coloured light sources on the decoration adopted.

Mr. C. J. King thought that with all schemes such as that described by Mr. Logan there was a great encouragement to illuminating engineers to "work to a type."

Mr. L. C. Kalff said that comfort was made up of a number of things of which absence of discomfort was only one. He would add ease of seeing, a situation in which we were freely attracted to what we wanted to see and not distracted by what we didn't want to see and, finally, a certain amount of pleasure. Mr. Logan's system gave no guidance as to the extent to which

The I.E.S. Secretary, Mr. G. F. Cole, and Mrs. Cole, at the President's Reception.

the attention was concentrated on the area of interest. Further, said Mr. Kalff, the normal direction of viewing was frequently at a downward angle and not horizontal as the author had assumed.

Dr. Walsh said that Mr. Logan's paper and that given by Dr. Stiles earlier in the day had approached the subject of brightness and glare in two very different ways. The physicist had based all his arguments on experimental facts, while Mr. Logan had approached the problem as a practical lighting engineer and had put forward a scheme for other lighting engineers to try out and possibly modify in the light of their experience.

In his reply Mr. Logan summed up his proposals by saying that the ideal condition to be aimed at was not one of monotony but one in which the environment was completely adjusted to the range of adaptation of the human organism.

Visit to Glyndebourne

After tea on the Wednesday afternoon a party of 180 took part in a very pleasant coach tour over Beachy Head and through the Sussex Downs to Glyndebourne, where they were shown round the theatre and the gardens by Mr. John Christie. Having gathered all the visitors together in the auditorium Mr. Christie explained the aims and objects of the Glyndebourne Opera and then in a provocative and amusing style described the system of stage lighting control which he employed in spite of all the efforts of the "experts" to convert him to the use of systems which he did not want. The party was then conducted round the stage—which, contrary to expectations from the narrowness of the proscenium, was found to be as large as the auditorium—through the dressing rooms and house into the gardens, where Mr. Christie showed some of the costumes, all of which are made at Glyndebourne. At this point some of the stage lighting experts present joined issue with Mr. Christie much to the enjoyment of Mr. Christie and all concerned.

Left, The Astronomer Royal proposing the toast of the Society. Centre, the President making his reply. Right, Mr. E. C. Lennox proposing the toast of the Guests.

It was not perhaps generally known at the time of the visit to all who took part that only that day Mrs. Christie had been taken into a nursing home in London from which Mr. Christie had returned hurriedly in order to take charge of the visit personally. An opportunity to thank Mr. Christie was taken by Mr. Lennox at the annual dinner on the Thursday.

Lighting and Photography Under Water

At the Session on Thursday morning, under the chairmanship of Mr. W. R. Stevens, a very interesting paper entitled "Problems of Underwater Illumination" was given by Mr. W. D. Chesterman, of the Royal Naval Scientific Service, and Mr. J. B.

Collins, formerly of that service but now with the Building Research Station.

Mr. Collins was the first speaker, and his account of the problems involved in underwater photography was illustrated with several short cinematograph films. In the first part of the paper the authors discussed the optical properties of sea water, with special reference to its spectral transmission and the scatter of the light passing through it. They mentioned that the light scattered at right angles to the beam was almost completely polarised, but little use could be made of this because only very rarely in their work was the direction of view exactly at right angles to the direction of the incident light.

After a reference to the use of the Secchi (white) disc for measuring the clarity of water, they described two photometric instruments devised for such work. One was the "hydrophotometer," a photo-electric instrument, which gave the percentage of light transmitted through 500 cm. of water. The other was a submersible luminance meter operating on the principle of the instrument described by Dr. Hopkinson in connection with his work on the photography of street-lighting installations. It was used to measure luminance and luminance contrasts in the underwater scene and to determine the correct exposure for taking photographs. The actual photography was done by a "free" diver, wearing breathing apparatus like that used by the frogmen and using a submersible cine-camera. This was electrically driven, and 200 ft. of 35 mm. film could be taken at one time.

The next section of the paper was devoted to a discussion of the visibility of objects under water with only daylight illumination. To study this the authors used a flat target, 4 ft. square, painted in several neutral tones from white to black and suspended from a boat. When luminance measurements had been made and the exposure determined, the camera man took the camera and swam away until the target was only just visible. Then, with the camera running, he swam steadily towards the target (altering the focus by means of the control operating through a watertight gland) until within one or two feet of it. The experiment was repeated with the target facing directly towards the sun azimuth, directly away (silhouette condition) and at right angles to it; the boat then moved to another location where the experiment could be repeated with a different water clarity.

Among the conclusions drawn from this work was the very practical one that the maximum range for a clear photograph of a white object in clear water was of the order of 30 ft., but that the corresponding range dropped to about 7 ft. when the water attenuation coefficient rose to 0.25 per ft.

For work by artificial light various types of sources were used. Research on the visibility of targets in searchlight beams (described by Mr. Chesterman and Dr. Stiles in a paper contributed to the "Symposium on Searchlights") indicated that the range would increase as the amount of illuminated water between the observer and the object was decreased. Thus the most effective method of illumination was from a source as close as possible to the object and not from a floodlight close to the camera. Another conclusion, also drawn from the work on searchlights, was that the effect of the intensity of the source on the range of visibility would be small, provided the scene brightness was above a certain limiting value. Taking everything into account and assuming an average reflection factor for the object of 30 per cent., it was concluded that an illumination of about 30 lm./ft.^{2} was required over an area of at least 3 ft. square, the area covered at a distance of 3 ft. by the short focus lens generally used.

Before full-scale sea trials were attempted, preliminary work was carried out in a large diving tank, and it was quickly confirmed that a close-range floodlight was the best source to use. Four such fittings were developed specially for the work, two using 250-watt and 400-watt mercury lamps (MA/V), and the other two sodium lamps of the 45-watt and 140-watt rating respectively. In the case of the fittings with sodium lamps, an outer acrylic case was used to protect the lamp.

Some remarkable examples of the photographs obtained under working conditions were shown. One was of a propeller well and truly "tied up" in a coil of rope with which it had become entangled. Another was a silhouette picture of a fractured plate in a sunken floating dock.

The Slow-Motion Camera Under Water

The final part of the paper was concerned with lighting for high-speed photography under water. This side of the work was described by Mr. Chesterman and, like Mr. Collins, he illustrated his account with a number of stills and cine shots. Both flash discharge lamps and lamps giving continuous illumination were used. After some interesting "slow-motion" pictures of the formation and collapse of steam bubbles in water, Mr. Chesterman showed a remarkable

Mr. C. R. Bicknell (Siemens) and Mr. Norman Boydell (South-Eastern Electricity Board), members of the Summer Meeting Committee and jointly responsible for the Dow Golf Competition.

picture of "cavitation" in which a rapidly rotating propeller blade was seen actually creating a hole in the water. The pictures showing the formation of the "cavities" at the propeller tip were taken at the rate of 2,000 per second. Other very interesting slow-motion pictures were of the discharge of torpedoes from the side of a submerged submarine and of the mode of escape to the surface from a submarine in case of emergency. A number of fascinating pictures of underwater scenery were also shown. Some of these were in monochrome and others in colour, and they demonstrated very clearly the great possibilities of underwater photography by the techniques developed by the authors.

After the authors had completed their presentation of the paper, a film made by the Crown Film Unit was shown. This covered some of the same ground but in a manner which would appeal to a semi-popular audience.

The discussion was opened by Dr. Stiles who said he would make a suggestion which was probably a very long-term project indeed. He wondered whether it would ever be possible to use a technique somewhat analogous to that employed in radar, the pulse of light used for illuminating the object being of such short duration that light reflected from objects not at about the same range as the object to be photographed could be prevented from entering the camera. He asked if scatter could be reduced by a careful selection of the colour of the light, any lack of sensitivity of the emulsion being compensated by increase of the exposure.

Mr. J. Score Smythe and Mr. J. M. Waldram stressed the similarity of the scatter problem under water to that encountered in work on visibility through haze in the atmosphere. Mr. Waldram said that from inspection of the scatter curves shown by the authors he would conclude quite definitely that the scatter was not molecular.

Dr. R. C. G. Williams thought that underwater photography might have very far-reaching effects if applied to the study of marine biology. He said that sea-farming might well become both practical and important in the not very distant future, having regard to the world food situation.

The solemnity of the proceedings was shattered by Mr. J. Walsh who referred to the competition for the Dow Cup. He thought that the authors could both raise the standard of play and earn a few guineas for a very deserving cause if they would apply their apparatus to the demonstration of shortcomings in the styles of the different competitors.

The authors, in their reply, displayed no enthusiasm with regard to Mr. Walsh's suggestion but they proceeded to deal with various questions raised by other speakers. In particular, Mr. Chesterman said that Dr. Stiles's scheme would require a flash with a duration of about one-hundredth of a micro-second. To develop the apparatus necessary for this purpose would be a research in itself. Dr. Aldington, in fact, had said during the discussion that, as far as he could see, one micro-second was about the shortest duration which could be expected having regard to the nature of the phenomena involved. Mr. Chesterman, however, mentioned the possible use of a Kerr cell to chop off the pulse of light required.

Mr. Collins said that the sources of light used had been those already available in suitable form. He thought, however, that the fluorescent lamp might prove very useful for other kinds of work contemplated for the future.

A reference to the use of the television camera for watching submarine phenomena was made by Mr. Chesterman who said that it had the great advantage of being usable

at any depth and, in addition, it could remain submerged for an almost unlimited length of time.

Annual General Meeting

The Annual General Meeting of the Society was held on the Thursday afternoon, when the President presented the Report of the Council for 1951. He drew attention to the continued steady growth in the number of members and congratulated the North Lancashire Group on their formation during the year and on reaching a membership of over 50 so quickly. The past year or two, he said, had also seen a significant increase in the number of student members, a tendency which he hoped members would continue to encourage. He also referred to the aim of the Society in promoting greater collaboration between lighting engineers and architects, an aim which the Council thought would be encouraged by the Dow Prize Competition, the first of which was to be held this year. The President thanked the officers and vice-presidents of the Society and the Hon. Editor for their work during the year, and the committees of Centres and Groups for their continued local activities.

The adoption of the Report was proposed by Mr. Harry Hewitt, of the Manchester Centre, who referred to the loss to the Society by the death of Mr. Ken Mackley, which was recorded in the Report. He said he thought the Report was a good one and showed that the affairs of the Society were in good shape; he thanked the Council and officers for their conduct of the administration during the year.

The proposal was seconded by Mr. N. Slater, of the Nottingham Centre, who said he was alarmed at the poor attendance of Centre representatives at Council meetings. He asked Centres to increase their efforts to arrange courses in illuminating engineering. Referring to finance, he said that acknowledgment should be made of the diligent and careful administration on the part of the various Centre treasurers.

Mr. Howard Long also raised a number of matters, pointing out that non-attendance at Council meetings was not confined to Centre representatives, and suggested that steps be taken to ensure that those nominated to serve as elected members would attend meetings.

The President briefly replied to the points raised and the Report was then declared carried. He then recalled that a ballot had been held for the eight vacancies in Council membership which would occur in October next, and declared that, as a result, those elected were: Mr. A. D. S. Atkinson, Mr. F. M. Hale, Dr. R. G. Hopkinson, Mr. R. A. Lovell, Mr. J. S. McCulloch, Mr. W. T. F. Souter, Mr. W. R. Stevens, and Mr. D. L. Tabraham. The Council's nominees for officers were duly elected, as follows: *President,* Dr. W. J. Wellwood Ferguson; *Vice-Presidents,* Mr. A. G. Higgins, Mr. E. C. Lennox, Mr. A. H. Owen, Mr. J. F. Stanley and Mr. W. J. P. Watson; *Hon. Treasurer,* Mr. W. J. Jones; *Hon. Secretary,* Mr. H. C. Weston; *Hon. Editor,* Dr. W. E. Harper.

At the conclusion of formal business a vote of thanks to the headquarters staff was proposed by Mr. G. E. L. Comrie, of the Edinburgh Centre.

What is Comfort?

The Annual General Meeting of the Society was immediately followed by a technical session at which the guest of honour, Mr. L. C. Kalff, of Eindhoven, gave an address entitled "Comfortable Seeing." Speaking in excellent English, he first referred to conditions in Holland immediately after the war and said that five years of black-out during the occupation had given the people a craving for light. This had led to a widespread development of lighting and a general raising of illumination levels. In the home, in the shop, in banks, in factories

The debate continues as Mr. L. C. Kalff (Philips, Eindhoven) emphasises a point to Mr. Logan and Dr. R. G. Hopkinson (B.R.S.).

and in fact everywhere except, perhaps, in government and other official buildings, lighting in Holland was at least as advanced as in any other country in Europe.

Mr. Kalff then referred in appreciative terms to the work carried out comparatively recently in America and he mentioned particularly the pioneer work done by Dr. Ward Harrison. A new era in lighting had, he said, been introduced by Dr. Harrison's paper in the journal of the American Illuminating Engineering Society entitled "What is Wrong with our 50 ft.c. Installations ?"

Until about 1920 the amount of light available was usually very scanty and it was almost inevitable that it should be used largely for what was, in fact, almost local lighting. As light became more abundant general lighting began to develop but the values were still very low judged by modern standards; 4 ft.c. was regarded as a very high illumination. Then came a rapid increase in lamp efficiencies, with the result that lighting levels everywhere were quickly raised. This increase was, however, not accompanied by any change of design method; all that happened was that the illumination was multiplied, often by a factor approaching ten, but the arrangement of the lighting remained the same. Then came Dr. Harrison's question, to which he gave the answer that when designing for 50 ft.c. it was not sufficient to follow the

Mr. A. G. Higgins (Vice-President) with Mr. Anthony Pott (Ministry of Education).

ideas and methods found suitable for an installation of 5 ft.c.

Thus Mr. Kalff traced the development of illuminating engineering, first from a preoccupation with the luminous intensities of light sources to a study of illumination as such and of the efficiencies of reflectors and of lighting fittings of all kinds, and then, more recently, from the consideration of illumination alone to a study of the brightness pattern in the field of view of the observer. Mr. Weston, in his discussion of Dr. Stiles's paper, had said that what mattered most was the pattern of retinal illumination produced on the eye but Mr. Kalff felt that the illuminating engineer ought to go even further than that and ask himself what effect that pattern had on the individual's reaction to his surroundings because it was this reaction that, in the long run, determined whether the lighting would or would not be considered "comfortable." Comfort was not just absence of discomfort. That was a negative quality which was essential but not sufficient. To it must be added, first, ease of seeing, then the power to attract attention to the most important object or part of the field of view, without distraction from objects elsewhere in the field, and, finally, pleasure.

To facilitate analysis of the lighting conditions in the field of view, Mr. Kalff said it was convenient to divide this field into three zones. The innermost of these embraced the area on which attention was desired. The size of this zone was about 10 deg. in width and 8 deg. in height. Next came the zone forming the immediate background to the first zone. This corresponded roughly to the area occupied by a picture which a spectator desired to see as a whole, without detailed attention to any one part. It was found that for this purpose the observer viewed the picture from such a distance that its width subtended about 22 deg. and its height about 17½ deg. at his eye. The third zone was the general background and this should contain nothing that would attract attention and so disturb the comfort of an observer wishing to concentrate on the pattern presented to his eye in the first zone.

Mr. Kalff then said that, as the cones which were responsible for the perception of fine detail and for the appreciation of colours predominated in the central portion of the retina, it was in the area within an angle of some 30 deg. from the line of sight that attention to colour and detail was chiefly needed.

After the paper by Mr. Pott; Mr. Mark Hartland Thomas (Council of Industrial Design), Mr. Cooke Yarborough and Mr. Pott leaving the Winter Garden.

Colour, Line and Brightness

Mr. Kalff went on to say that three things contributed to making an object easily seen: these were colour, line and brightness. So-called " warm " colours, reds and yellows, generally attracted attention and so were most desirable in that part of the field of view containing the visual task. Elsewhere, especially in the peripheral field, these colours should be avoided in favour of blues and greens. As regards the influence of line, attention was directed to an area either by lines radiating to that area or by curved lines surrounding it. An irregular pattern of lines drawn in many different directions was confusing and tended to prevent concentration on any particular area. Brightness was attractive and so brightnesses should be high in the region requiring attention and low elsewhere. These rules were then illustrated by reference to well-known paintings; in particular Hobbema's "Avenue" demonstrated the use of radial lines to give unity to a landscape by directing the eye to the centre of the picture, while in Fragonard's " The Swing " all three devices, high brightness, warm tone and curved lines suggested by the surrounding detail, were pressed into service to make the female figure the centre of attraction.

The lecturer then put forward a very strong plea that the illuminating engineer should speak to the architect in a language the latter could readily understand. The architect of to-day, he said, had a very heavy responsibility and was preoccupied with many things beside lighting; it was essential, therefore, that any advice which the lighting engineer had to offer him should be presented in a readily assimilable form.

Mr. Kalff next mentioned that, as part of the celebration of the golden jubilee of the Philips' organisation, the original factory, opened in 1891, had been converted for use as a kind of museum with a number of demonstration laboratories. In one of these a model room had been erected and visitors were invited to make a choice from a number of different colour schemes. In this way it had been possible to try out the reactions of a large number of observers.

In the final section of his lecture Mr. Kalff showed a number of colour photographs of different interiors decorated, some in accordance with, and some contrary to, the principles he had described. The interiors shown included a shop window, a canteen, a church, a club room and, in several cases, the same interior was shown with different schemes of colour decoration

Regarding the use of colour in factories. Mr. Kalff said that warm colours should be reserved for objects to which it was important that the worker's attention should be drawn; blues and greens should be used for those objects or areas which he could " take for granted," and which were more or less incidental to the actual work.

No pre-prints of Mr. Kalff's address were issued and, as usual in the case of the address given after the Annual General Meeting, there was no discussion. A vote of thanks were proposed by Mr. R. O. Ackerley, who spoke in appreciative terms, both of the way in which the lecturer had expressed himself, almost without referring

An international session with Dr. Hopkinson, Mr. A. G. Penny (G.E.C.), Mr. Logan (New York), Mr. B. Knudsen (Copenhagen) and Mr. Kalff (Eindhoven).

to any manuscript, and of the very thoughtful and thought-provoking ideas which he had put forward. Appreciation of this remarkable lecture, said Mr. Ackerley, could best be shown by a resolve on the part of every illuminating engineer present to try out for himself what he had heard described that afternoon. He concluded by urging that Mr. Kalff should give his address, not only to illuminating engineers in all parts of the world, but to architects as well. This, said Mr. Ackerley, he was well qualified to do because he was himself an architect. The vote of thanks was seconded by Mr. J. M. Waldram and carried by acclamation.

The Annual Dinner

The annual dinner and dance was held at the Grand Hotel, Eastbourne, on the Thursday evening, when some 280 members and guests were present. The principal guest was the Astronomer Royal, Sir Harold Spencer Jones, and Lady Jones. Unfortunately, owing to the illness of Mrs. Christie, Mr. John Christie was unable to be present at the dinner and to reply on behalf of the guests, this task being undertaken at very short notice by Alderman Martin, the newly appointed Mayor of Eastbourne.

The Astronomer Royal said that ever since he had been asked to propose the toast of the Illuminating Engineering Society, he had been wondering why a mere astronomer should have been so honoured. He said that of all the citizens of this little world an astronomer was surely the most unsuited. The astronomer was always endeavouring to get away from light which was one of the reasons why he himself was now living in the near vicinity of Eastbourne and why the Royal Observatory was in the process of removal from Greenwich to its new home at Hurstmonceaux. An astronomer dealt with objects at very great distances and when groping out into space and endeavouring to photograph and study the spectra of objects which were so far away that their light had taken something like a thousand million years to reach the earth and whose brightness was of the lowest possible magnitude, even quite a little light was a troublesome matter. Astronomers, he went on, were faced with problems with which lighting engineers were not concerned; there were limitations on the exposures which could be given even in an absolutely dark sky, a sky which was not interfered with in any way by artificial illuminations with which the Society was concerned. But then, of course, no sky was ever absolutely dark; not only was there the light of innumerable distant stars, but also the faint glow of the night sky due to that permanent faint aurora which, though not visible to the naked eye, was clear in the astronomer's telescope and which, if a sufficiently long exposure was given, fogged his plates and caused his faint distant objects to be blotted out. So the astronomer liked to get away from light and for that reason it seemed inappropriate that a mere astronomer should have been asked to propose the toast of the Society.

This, however, was only one aspect of a very great problem, but there were other aspects on which he could meet the Society on common ground. One must have artificial illumination, but as little as possible of that illumination should be wasted. Why

should there be types of amps which threw a lot of light upwards, light which was wasted as far as the ordinary citizen was concerned and which was eventually a great nuisance to the astronomer. The astronomers would be grateful for anything that could be done to secure more efficient exterior lighting to get the best and most uniform illumination of road surfaces for the minimum expenditure of energy and the minimum wastage of light.

There were many problems, he said, with which the Society had to deal, and he felt sure that the Society had a very fruitful and a very useful field of work open before it.

After thanking the Astronomer Royal for his kind remarks, the President said that he was regarded as the keeper of the most accurate time the world had ever known, and as the most far-sighted man of our day, and it was only to be regretted that the light by which he saw travelled so slowly and that he was millions of years behind the times in some of the events which he observed.

Members of the I.E.S. were interested in the nature of light and in the nature of vision and in everything which happened in between — the production and control of light, the illumination of the object seen and the physiological and psychological reactions in the eye and brain. It was an enormous range of interest and, being a cultural body as well as scientific and technical, the Society was interested in education, in developing appreciation and enjoyment of good lighting and also in dignified propaganda for the proper use of light. He referred, very briefly, to two cultural activities — exterior and interior lighting.

This year, he said, saw the coming-of-age of floodlighting as it was known in this country, for it was 21 years since the International Commission on Illumination met in London, and the late Mr. Percy Good, a past-president of the Society, organised the first floodlighting of London. Floodlighting in London was soon to be seen again — it would be delightful but it would be the same as before—some of the noble buildings and some of the monuments would be illuminated. It would be spectacular but, because it was not directly related to the life of the community, it would be switched off in the autumn. We should have more floodlighting for general use and pleasure, not just for spectacular and decorative lighting but for recreation and for amenity.

There was also a real demand for floodlighting of games' pitches in parks. The lighting of St. James's Park for the Jubilee in 1935 was still remembered as probably the happiest example of beauty in floodlighting. Nowadays the idea of floodlighting was to illuminate buildings and monuments. A return should be made to floodlighting what the planners called movement areas, for evening games and recreation in a good light without glare.

As for interior lighting, everyone knew of the I.E.S. Code for the Lighting of Building Interiors. This was kept up to date, but it was based on fundamental rather than economic considerations. It was very highly

Mr. H. G. Campbell chatting with Mr. C. J. Misselbrook (Siemens) and Mr. H. Hewitt (North Western Electricity Board).

regarded in this country and abroad—the International Commission on Illumination last year endorsed it in a way that its principal author, Mr. H. C. Weston, must have found very gratifying. The French Society—the Association Française des Eclairagistes—was now working on a code which was so similar to the British one that it was possible that a common basis for the two countries might be adopted.

During the past ten or fifteen years a revolution in factory lighting had been witnessed, and the same thing was happening in school lighting. In both these, the accumulated experience of the Society had been made effective by Government orders. But what of office lighting?—a revolution was also taking place there without any pressure from official circles. This was because good

lighting justified itself. A Departmental Committee had been set up under the Building Research Board to look into office lighting—that Committee had finished its work three years ago and the report submitted to the Minister at the end of 1949. He now assumed it lay covered with dust in his successor's pigeon-hole. He said he was sorry not so much because of the disappointment of the Committee members—most of them members of the Society—but because the world at large was prevented from knowing their conclusions, and he was concerned that the revolution in office lighting might be over before Her Majesty's Government had published the rules.*

He had, he said, mentioned these two cultural matters because he wanted to remind the Society that it was not enough to hold technical sessions and to publish Transactions, however good they might be. The Society had a duty to its scientists and technicians to give a lead in the application of their work and to show a close interest in those decisions of high policy which were taken nowadays at Government level and which influenced the work and activities of the members of the I.E.S.

Mr. E. C. Lennox, proposing the toast of "The Guests," said how pleased the members were to have as Guest of Honour the Astronomer Royal, who had already referred to the unfortunate fact that it was the efforts of some members of the Society that had moved him from his ancient seat at Greenwich to the Castle at Hurstmonceaux. He felt sure that Sir Harold and Lady Spencer Jones would in time come to bless the Society for that effort, which had been made quite inadvertently, because of the beautiful surroundings in which they now found themselves. Sir Harold, in common with Astronomers Royal of our nation, had brought added fame to the work of his wonderful profession. As far back as 1884 the work of the Astronomer Royal had been recognised by the allocation of the zero meridian through Greenwich. Now that he had moved his abode to Hurstmonceaux, it was possible that there might be some form of time called "Hurstmonceaux Mean Time"—but that might or might not be. Quite recently Sir Harold had found a way of measuring the distance from the sun to the earth; he had taken measurements in various parts of the world and had discovered a distance which was correct within 9,000 miles. To those who knew very little about this problem, this would seem a not very accurate estimate, certainly not a commercial one, although this was well within a very small percentage of one per cent.

* See p. 222.

It was very much regretted that Mr. Christie had been unable to be present. It would have been an opportunity to thank him for the pleasant and instructive visit paid by the Society to Glyndebourne. What had been seen and learnt from his personal interpretation of his work had given great pleasure. It had been a privilege to hear him, and his lecture to electrical engineers on the arts of dimming lighting had, he felt sure, been taken to heart. Everyone sincerely hoped that Mrs. Christie would be soon restored to good health and the beautiful surroundings of her home.

He then went on to welcome to what was probably his first official function the new Mayor of Eastbourne, Alderman Martin with the Mayoress, Miss Martin. He was glad that Alderman and Mrs. Croft, who were now the deputy Mayor and Mayoress, had come along, as it was with great delight that their welcome, as the then Mayor and Mayoress, had been received on the previous Tuesday evening.

Considerable assistance which had been afforded to the Society during the conference from the officials of the County Borough had been recognised in a small way by inviting the officials who had been so helpful. Among other guests were representatives of kindred bodies, and it was also a pleasure to welcome those who had come from other countries, especially Mr. Logan from the United States and Mr. Kalff from Holland.

The Mayor, Alderman Martin, replied on behalf of the guests.

School Lighting

On Friday morning the chair was taken by Mr. A. G. Higgins, and a paper on "Lighting in the Design of Schools" was read by Mr. Anthony Pott, of the Architects and Building Branch of the Ministry of Education. He said that the term "schools" embraced a very wide variety of buildings and in his paper he had dealt only with primary and secondary schools and, in the case of the latter, mainly with the secondary modern school, a new product of the 1944 Education Act with problems of its own educationally and, therefore, also architecturally. Organisation, curriculum and teaching methods were, he said, live subjects of experiment and controversy, so that new buildings should, at the worst, allow such

Delegates outside the Winter Garden.

experiments to be carried out and, at the best, encourage and even stimulate them.

The planning of new schools was influenced, not only by their subsequent use, but also by building methods and by economic considerations. Building methods, in their turn, were greatly affected by material shortages. A particular example of the effect of these influences was to be seen in the reduction of the heights of rooms in some of the newer schools. This, said Mr. Pott, had the advantages of creating a more homely or intimate atmosphere and of reducing costs, but it complicated some of the architect's other problems, including the lighting.

With modern methods of teaching a classroom had to be planned as a multi-purpose room in which "project" work by small groups of children could be carried on in addition to the more formal teaching from the blackboard. Then there was a revival of the school built on more than one floor and a re-examination of the use and design of assembly halls so that they could be more frequently occupied than was customary in the older types of school.

Mr. Pott then turned to the subject of lighting standards and quoted the School Premises Regulations issued by the Ministry. These called for a minimum maintained illumination of 10 $1m/ft.^2$ by artificial lighting and a 2 per cent daylight factor in all teaching accommodation and kitchens. It was pointed out in the paper that schools were mainly lit by daylight and the main job of the artificial lighting was to supplement the natural light when this was inadequate. The period of use of this supplementary lighting might well be as little as 50 to 60 hours per annum. Mr. Pott then made the rather surprising statement that in a number of schools designed to a sky factor of 2 per cent. the measured daylight factor had been found to be about 5 per cent. The teaching rooms in most post-war schools, he said, were lit by windows in at least two walls, a window wall proper on one side and clerestory lighting in the opposite wall. A fairly recent development was the introduction of top-lighting in single-storey schools and in the single-storey parts of other schools. This had certain drawbacks, even from the lighting point of view, and a louvre system was sometimes necessary to obtain a satisfactory brightness distribution in the room.

This led to a consideration of the problem of the multi-storey school in which a certain number of classrooms had to be lit from one side only. There was no difficulty, the author said, in complying with the requirement of 2 per cent. daylight factor over the whole teaching area, but it was much harder to obtain a light distribution which would give a generally satisfactory visual environment. Some form of daylight control was necessary, and venetian blinds, properly contructed and intelligently used, seemed to provide the best solution. This also was the opinion of Professor Biesele in the United States. Failing the provision of venetian blinds, the use of simple net curtains seemed to merit a trial.

Turning next to artificial lighting, Mr. Pott referred to those parts of the regulations

dealing with the "quality" of the lighting as distinct from the value of illumination provided. In particular, there was a limit to the brightness of fittings and a provision (described by Mr. Pott as "sound but vague") that the fittings should distribute some of their light "so as to prevent excessive contrast between the fittings and their background."

After some remarks on the lighting of chalk-boards and pin-up boards, the speaker referred to the brightness of fittings. He thought that a careful grading of brightness from centre to edge was much more attractive than a dull uniformity, and the same applied to the brightness ratios of all surfaces within the field of view. Too little contrast could be nearly as unsatisfactory as too much, although in a different way. To judge by published photographs, American schools suffered from too little variation of brightness and it was hard to believe that some of the rooms illustrated gave much help to the teacher in firing the imagination of the children or in stimulating them to creative activity. Recent work, said the author, had shown that a rigid limitation of brightness ratios was not necessary for the avoidance of discomfort; more positively, some "sparkle" and the absence of monotony could increase the comfort.

A Simple Fitting for Schools

Turning to the design of fittings, Mr. Pott said that the light output should be approximately equally divided between the upper and lower hemispheres, the cut-off angle and the brightness should comply with the regulations, the design should be neat in appearance and not obtrusive either in use or out of use and, finally, the fitting should cost a few shillings and not several pounds. The reduction of ceiling heights made necessary the use of more and smaller fittings and the use of the fluorescent lamp was likely to increase. Mr. Pott criticised the cumbersome fittings often used with this lamp, and asked why something like the simple design evolved at the Building Research Station had not been more fully exploited.

The final section of the paper dealt with decoration, and it was mentioned that interest in the use of colour was increasing and the bolder use of it becoming more common. At the same time, it was necessary to pay careful attention to the reflection factors in order to preserve a proper brightness distribution. In particular, the upper parts of the walls should not be much less bright than the ceiling so as to preserve a reasonable grading of the brightness of the fitting to that of its immediate background. Mr. Pott concluded his paper with a word on the choice of furniture and a strong plea for the co-operation of all concerned in order to achieve the best results.

There was a very lively discussion, opened by Mr. C. W. M. Phillips who referred to the very bad conditions in some of our old schools. He said that the illuminating engineer was concerned with reflection factors rather than with colour, which was more properly a matter for the architect. He pleaded for more harmony between the fittings and the ceiling on which they were mounted and said that ideally both should be designed together.

Mr. Mark Hartland Thomas, of the Council of Industrial Design, objected to the use of highly polished finishes for desks and other furniture with their attendant specular reflections. Sparkle, he said, was a good thing when the eyes were raised from the work but should be barred in the working field of view. Properly designed lighting could assist the teacher. For instance, if pools of light could be created at different parts of the room, this would greatly help the formation of small groups of pupils for project work. He criticised "fussy" ceiling construction and made the suggestion that the desirable gradation of brightness between a window and its surround might sometimes be achieved by a judicious use of glass bricks, e.g., in the blank wall between window and clerestory.

M. Jean Chappat referred to the controversy about the use of fluorescent lighting in schools and its condemnation by the French Ministry of Education. He described experiments which were in progress in Paris and promised that the results of these would be communicated to the Society as soon as they were available.

Mr. A. G. Penny said that now light was so abundant it could be used not only for illuminating what had to be seen but also as a positive help to the teacher, the salesman and others in carrying out their work.

Mr. J. Studholme and Mr. W. Boissevain took up Mr. Pott's challenge regarding the design of fittings. The absence of the control gear from the picture of the B.R.S. fitting was pointed out and the necessity for easy maintenance was stressed; to this end the louvre system should be readily removable from below.

Mr. Pott, in his reply, said that he felt the biggest problem in school lighting was how to get the knowledge of the illuminating engineer applied to the lighting of the classroom. He felt that the only solution was closer collaboration between the Illuminating

Engineering Society and the Royal Institute of British Architects. (Perhaps those responsible for the Dow Memorial Prize competition will take note of this remark.)

Fittings for Fluorescent Lighting

At the final technical session on Friday afternoon, Mr. L. H. Hubble read a paper entitled "The Design of Interior Lighting Equipment" in which he gave an interesting account of major developments in the design of fittings for interior lighting by gaseous discharge lamps and fluorescent lamps. He did not touch on fittings for tungsten lamps because, he said, there was so little progress to record in this field.

The author first described briefly the fittings used with 250-watt and 400-watt H.P.M.V. lamps, especially those designed for horizontally burning lamps, either alone or in combination with tungsten filament lamps. Most of the paper was, however, concerned with fittings for fluorescent lamps. Mr. Hubble first listed the standard types of fittings available and showed how, even in the case of the simple industrial trough fitting, a very large number of different varieties would be needed in order to cover all possible combinations of requirements. Some degree of rationalisation and interchangeability of parts was essential in order to keep the situation within reasonable bounds. The problems of stocking, packing and transport had also to be considered by the designer.

Mr. Hubble then passed on to a consideration of non-standard designs such as were required for cornice lighting or for lighting from the crane rail in, for example, the turbine house of a power station. He showed how such requirements could be met by the use of a limited range of carefully designed components. Of particular interest was the extensive use of extruded aluminium sections, sometimes with a Tee-slot which allowed the lamp control gear to be fixed readily at any position along the section. For arranging the lamps in continuous lines, extruded aluminium trunking was used in lengths of 20 feet or more. It was suspended by stirrups clipped on at intervals and the lamps, control gear and reflectors were mounted on a channel carried by the trunking. In this way the maximum degree of freedom was provided and it was easy so to arrange an installation that the lamp layout could be modified without any interruption of the lighting.

The author then went on to describe how similar principles could be applied in the case of flush louvred and flush panel lighting. He said that continuous panel lighting offered most difficulties since the control gear had to be housed above the reflectors and bridge pieces formed to connect the longitudinal ceiling members over the top of the fittings. Unless, therefore, continuous panels were essential, he recommended that the runs should be split by blank intervals of a foot or so, allowing the control gear to be placed more accessibly and making both manufacture and erection much easier.

Rationalisation or Standardisation?

In conclusion, Mr. Hubble said that the many new methods of applying light, and the large range of industrial applications,

Mr. Weston taking leave of Mr. Kalff at the end of the meeting.

each with certain special requirements, could easily produce a situation which was quite chaotic and unmanageable from the point of view of the fittings designer. Rationalisation, therefore, was essential wherever possible, and there were signs that this was being realised. Already fittings for cornice lighting were being standardised, and in America the "module" and other unit constructions had been developed.

At the conclusion of Mr. Hubble's address the Chairman, Mr. N. Boydell, spoke appreciatively of the work of the fittings designer and of the way in which the speaker had dealt with such a large subject. Mr. A. H.

Olson added his appreciation, but said he could not agree that the design of fittings for tungsten lighting had made no progress. He disliked dual fittings for blending tungsten and discharge tube lighting, and thought a much better solution was area lighting, using the lamps behind a suspended ceiling. Heating was the main difficulty, and the designer had to be careful to take this into consideration.

Mr. Cooke Yarborough, as an architect, pleaded for more standardisation of dimensions, and mentioned a case in which difficulty had been caused by quite small differences between fittings of the same type made by different manufacturers. He expressed strong distaste for the louverall ceiling, which he considered soporific and lifeless. He showed a number of interesting pictures of a large factory with a roof consisting of a number of shallow domes. The artificial lighting had been arranged to have much the same distribution and to appear to come from the same directions as the daylight. This very satisfactory result had been achieved by early and close co-operation between the architect and the illuminating engineer.

Dr. H. H. Ballin, after speaking of the advantages and disadvantages of combined ballasts for fluorescent lamps, said that, while he agreed with Mr. Cooke Yarborough that a louverall ceiling could be very dull if metal louvres were used, a much more stimulating effect could be obtained with plastic.

Mr. H. F. Stephenson asked why the author had measured angles of cut-off from the horizontal; surely the orthodox method was to measure them from the downward vertical. Although there was little risk of confusion when the angle was small, when it was 40 deg. or 50 deg., as it might well be with louvres, there was considerable chance of ambiguity unless the standard system was followed.

Mr. S. Anderson said that there were two stages in the development of an article at which standardisation might be undertaken. It could be standardised without much trouble before manufacturers had invested much money in tools and equipment, but if this was done much of the specification had to be inspired guesswork. It could also be standardised after experience had led to practical agreement on a more or less stereotyped pattern. He felt that the fluorescent fitting was at a stage intermediate between these two, and that to attempt to standardise it now would be to stifle initiative and to retard progress.

This point was taken up by Mr. Hubble in his reply. He said that what he had described was not standardisation but rationalisation, which he defined as designing so that the maximum number of different requirements could be met with a minimum variety of separate and diverse patterns. He agreed that any system, whether louverall or ordinary indirect lighting, which gave a completely uniform ceiling was soporific; some pattern was much to be preferred.

Closing Session

On the conclusion of the discussion on the paper by Mr. Hubble, the President brought the meeting to a close.

He first announced that the Dow Golf Cup had been won by Mr. Donovan Allom who had not only submitted the winning card but also the second best card. Unfortunately Mr. Allom had had to leave and was unable to be present to receive the cup.

Summing up the Summer Meeting the President expressed thanks to all who had contributed to its success including the Corporation of Eastbourne and its officers, the authors and speakers in discussions, members of the Summer Meeting Committee under the chairmanship of Mr. Stevens and the members of the Papers Committee under the chairmanship of Mr. Waldram. He also thanked Mr. Ossitt and his colleagues who had been responsible for the stage management which had resulted in the most efficient running of the technical sessions all of which had started on time. On this latter point he said that members were to be congratulated that in spite of the perfect weather they had been able to resist other attractions and to get to the meetings before the advertised times; this also spoke most highly of the quality of the papers.

Mr. Stevens proposed a vote of thanks to the President and Mrs. Holmes which was carried with enthusiasm. The President briefly replied and the meeting then closed.

The raising and lowering gear used in the high bay lighting installation described on p. 218 of the last issue was supplied by the London Electric Firm.

The photograph of Trinity Congregational Church on p. 192 of the last issue was reproduced by kind permission of the Architectural Press, Ltd.

Association Française des Eclairagistes

The annual meeting of the French I.E.S. took place at Toulouse recently. Though similar in some respects to the I.E.S. Summer Meeting, it will be seen from the following report that it differed slightly in scope.

The annual meeting of the Association Française des Eclairagistes was held in Toulouse from April 30 to May 4 and was attended by over 300 lighting engineers, including representatives from Holland, Spain, Italy, Belgium, the United States and Great Britain. This was the first meeting of its kind arranged by the A.F.E. and its success will no doubt be followed by similar meetings in other parts of France in future years.

Though both the French and the British meetings (reported elsewhere in this issue) serve the same purpose in getting members of the respective societies together they are slightly different in their scope. Whereas a limited number of papers are presented at the British meeting and as much time as possible given to discussion, the A.F.E. endeavour to cover as many subjects as they can in the time available with hardly any discussion. As might be expected, in general French lighting engineers need to have a wide general knowledge of lighting and few of them have the opportunity to specialise. On one day at Toulouse as many as ten papers were given—rather more than we would expect a British meeting to accept willingly, but the audience at Toulouse seemed to increase rather than decrease during the day.

Advantage was taken of the occasion of the visit of so many lighting engineers to Toulouse to carry out extensive floodlighting on a scale which had not previously been attempted before in that city. Many of the most attractive old buildings were illuminated and great crowds gathered in the streets to see the beautiful effects which were achieved. There is no doubt that the French are very appreciative of floodlighting—even in the smallest towns it is not unusual to find some old building skilfully floodlit every night—and they are to be congratulated on the artistic manner in which many of the installations at Toulouse were handled even though in the majority of cases there was very little space due to the narrowness of streets in which to manoeuvre the projectors.

There were a number of demonstration street lighting installations, including several with different arrangements of fluorescent lamps.

Another feature which attracted large crowds of the general public every evening was the exhibition of lighting and lighting equipment which was held in the "Salon de la Lumière" in the Palais des Arts. The principal French manufacturers of lamps and lighting equipment exhibited their products in great variety. On the first floor there was a well-arranged display by Electricité de France illustrating the principles of lighting in which fluorescent materials were used effectively. One particularly striking exhibit was a model of the city of Toulouse with its floodlit buildings and street lighting as seen "from a helicopter," including the running water of the Garonne in which the lights twinkled.

French equipment does not differ very markedly from the British, but some points of interest were noted in the work seen at the exhibition. There was an increasing use of polystyrene louvres in a variety of forms and sizes, and there were various forms of reflector lamp not available in

M. André Claude (President of the A.F.E.), Mr. C. A. Atherton (General Secretary of the C.I.E.), and Mr. A. G. Penny.

Britain. The oval street lantern widely used in France was shown by a number of makers; in some instances the oval reflector itself was of glass housed in a circular body for ease of manufacture. The Saunier-Duval model was particularly well made in cast alloy, and contrasted with some other designs which seemed too flimsy for outdoor use. There were several fluorescent street lanterns, one of which employed a cold cathode tube, bent into three sections, each in its own reflector ("GAL"). Another lantern was sturdily built in aluminium and protected with silicone varnish for use in marine situations.

There were several floodlights, mostly with aluminium mirrors; one exhibition floodlight had a body of galvanised iron. Several makers showed flameproof and watertight fittings, one of which (Claude Paz et Silva) was a watertight fluorescent fitting used in the lighting of the tunnel at Croix Rousse. The photographs of the portals of this tunnel, with panels in the roof consisting of banks of 26 high tension tubes "set solid," to aid drivers entering on a bright day, were very impressive.

The display of decorative lighting fittings was outstanding and was an example of an art in which French designers excel.

Opening Session

The opening session, and the meetings during the first two days, took place at the Chamber of Commerce when delegates were welcomed to the city by the Mayor of Toulouse, after which the President of the Association Française des Eclairagistes, M. Andre Claude, reviewed the functions of the Association and explained why it had been decided to hold this meeting for the first time outside Paris. Mr. Maurice Leblanc, a vice-president of the Commission Internationale de l'Eclairage, spoke of the work of the Commission, and reported on the Stockholm meeting.

Dr. Merry Cohu then reported on progress in connection with the preparation of the recommendations for interior lighting now being drawn up by the A.F.E. He said that the responsible committee had carefully studied the British Code and the original work of Mr. H. C. Weston and others on which the Code was based. It was understood that the draft recommendations had been circulated for comment, and we shall look forward to seeing the recommendations in due course.

During the course of the opening session Mr. G. F. Cole, Secretary of the Illuminating Engineering Society, took the opportunity of conveying to the A.F.E. the greetings of the I.E.S. In the course of his remarks he referred to the possibilities of greater co-operation between the two bodies.

Lighting Principle

The first paper under this heading was one by Mr. Jean Maisonneuve entitled "Lighting and Brightness Considered from the Practitioner's Point of View." He said that vision brought into play two factors—lighting and brightness. In effect, the visual aspect of a luminous source and of a lighted surface depended on the lighting of the retina, which was itself proportional to the brightness of the source or of the surface. All experimental studies had, however, confirmed that brightness controls the precision and rapidity of vision as well as visual comfort. It was wrong, he said, for lighting engineers to base their lighting schemes on lighting values only and said that brightness should also be included in their calculations. Much research had been carried out on the question of brightness, and results had been published, and it was up to the lighting engineer to make the maximum practical use of the available information. He said that at the present time there was no brightness meter available on the French market, although a convenient apparatus

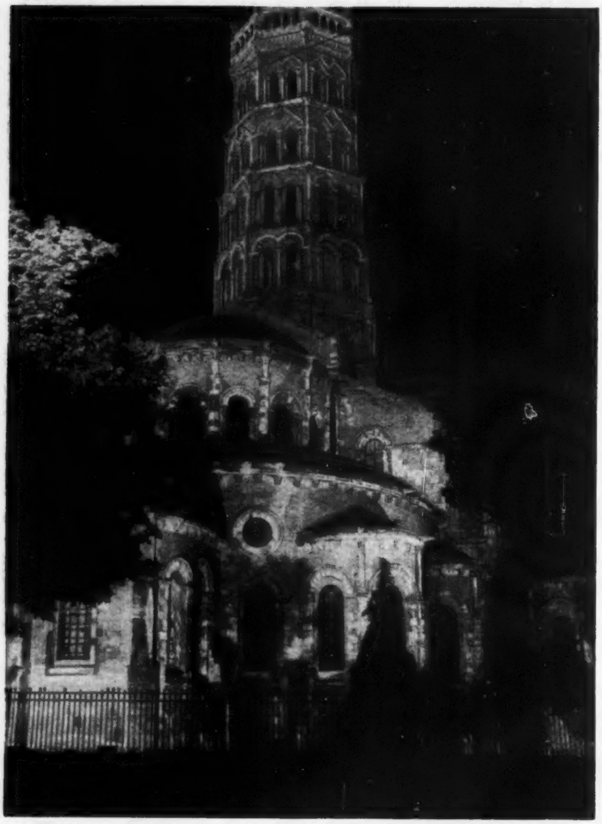
was being developed, the use of which he thought would contribute to the development of brightness technique.

In the discussion on Mr. Maisonneuve's paper Mr. J. M. Waldram (Great Britain) said that the importance of brightness rather than illumination in determining the excellence of an installation had been recognised for many years, but he thought that the characteristics of the brightness distribution which determines the qualities of the installation were not yet known. Work on street lighting brightness distributions had indicated that neither the ratio of maximum to minimum nor the rate of change of brightness adequately explained the effects of patchiness. American recommendations for brightness distributions were each based upon some different fundamental assumption, but so far as he knew these assumptions had not been tested. He thought that a very important feature of brightness distributions was the directional effect, and showed slides in illustration of this point. He welcomed Mr. Maisonneuve's suggestion to study existing installations to determine what were the important characteristics. It was essential to establish the principles systematically before formulating too rigid recommendations.

Following Mr. Jean Maisonneuve's paper, Dr. Hopkinson, of the Building Research Station, England, gave a summary of recent work based on a programme drawn up during the informal conference on glare and visual comfort which he had convened at Stockholm (*Light and Lighting*, October, 1951, p. 328). The results of this work had confirmed that the differences between the mean evaluations of glare-discomfort obtained in the United States and on this side of the Atlantic were less than the variance of the evaluations of individual subjects in the observing teams. It would, in fact, require a very large number of observers to establish a "true" relationship, a task comparable with that which led to the establishment of the C.I.E. Photopic Visibility Function. In Dr. Hopkinson's opinion, the work would not be justified, and instead he proposed a mean formula, based on all the published work, which would serve the lighting engineer in his daily work until tables, drawn up with a proper weighting applied to each investigator's results, could be supplied, a task suited to the C.I.E. organisation. Dr. Hopkinson also referred to an extension of the B.R.S. work on glare-discomfort to include the effect of the contrast-grading of the visual task into its surroundings. The value of such contrast grading was most evident under high illuminating levels,

Mr. C. A. Atherton and M. J. Ayral (Compagnie des Lampes).

Mr. A. G. Penny, Dr. R. G. Hopkinson, Mr. E. B. Sawyer, Mrs. Penny, M. Antebi and Mrs. Sunderland.



Church of St. Sernin, one of the many buildings floodlit during the week of the conference.

emphasising the need to integrate the decoration of an interior with the lighting.

Mlle. Jeannine Parent, in presenting a paper by herself and Dr. Merry Cohu on errors in the measurement of light and their avoidance, said that although a knowledge of brightness engineering was becoming more desirable when planning lighting installations, the measurement of light is and always will be of definite importance. Errors of measurement were quite common with photocells unless special precautions were taken; different methods of correction have been studied and their respective merits compared. The authors said they hoped that the manufacturers of photo-electric photometers would take steps to ensure greater accuracy of their instruments so that comparisons between readings taken by different makes of instrument would be possible.

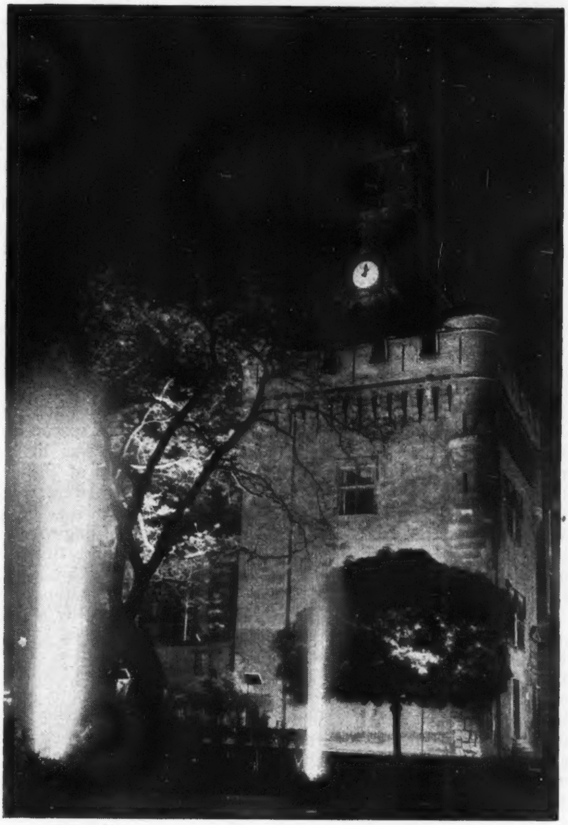
Mr. L. C. Kalff, of Eindhoven, then spoke of the attainment of comfortable lighting, a problem which, he said, should be approached at least as much from the artist's point of view as from that of the engineer. (See also report on I.E.S. Summer Meeting, p. 231.)

The last paper in this session on principles was that by Mr. Deribere, who spoke of the relationship between coloured ob-objects and their surrounds, and described some of their research now being carried on in France on the relationship between lighting and colour.

Public Lighting

The Thursday morning session was devoted to street lighting when Mr. Felix Prat, City

View of the Donjon du Capitole.



Engineer of Toulouse, dealt with the lighting of roads in towns, and Mr. Andre Herzog described the development of illuminated road signs. In a brief discussion on the paper by Mr. Prat, Mr. J. M. Waldram said that British engineers had been very interested in experiments on fluorescent street lighting in France and particularly in Belgium, and he described work done in England which had been inspired by the installations seen in Brussels and Charleroi. In these installations very good results had been obtained with simple diffusing lanterns at close spacing, and he had been interested to discover whether the refractor or reflector lanterns used in Great Britain, in which the light distribution was carefully controlled, were really necessary under these conditions. Experiments on complete installations were inconvenient, so a single lantern was studied. It was carefully photometered in the laboratory with both diffusing and prismatic enclosures, and was then erected on a chosen column in the street. The illumination on the ground was measured, and the bright patch formed on the road was studied in detail by photographic photometry for both the diffusing and the prismatic enclosures under identical conditions. It was found that the bright patch was approximately 2.6 times as bright with the prismatic enclosure as it was with the diffusing one. Glare could be estimated only by calculation, but on the basis of Hopkinson's results it was found that the glare in a complete installation would be very slightly greater with the

Mr. A. H. Manwaring (U.S.A.), Mr. J. M. Waldram, Mr. M. N. Waterman, Mrs. Manwaring and Mrs. Waterman.

prismatic enclosure, the increase being barely noticeable. It was concluded that even at the shorter spacings there were advantages in the more exact control of light. Mr. Waldram also described the experimental installation made last year at Eastbourne, and showed some slides of recent British installations.

The remaining paper in this session was a most interesting one on "Lighting of Roadway Tunnels," by Mr. J. Olivier. He said that the problem to be solved was essentially the same as any other public lighting problem, the requirements being uniformity of illumination, absence of glare, etc. An additional requirement, however, was the distribution of light on the surroundings or sides of the tunnel in addition to the road surface itself.

The main difficulty was in lighting the entrance. By day seeing conditions in the mouth of a tunnel were most unfavourable and one got the impression of driving into a "black hole." The motorist entering the tunnel passed from a lighting level of anything up to 15,000 lm./ft.^{2} of daylight to as little as 3 lm./ft.^{2}. It must be realised, he said, that the entrance was a transitionary zone which should be as long and as well lit as was economically possible.

M. Jean Chappat, M. Henri Maisonneuve, and Mr. Gaymard.

He went on to describe the various light sources that could be used, including incandescent, sodium, and fluorescent lamps. He then cited the Croix Rousse tunnel which had been lighted by Claude Paz and Silva using fluorescent lamps after experiments by the Department of Roads and Bridges. In this case the entrance lighting was reinforced and divided into three zones: interior, intermediate and entrance. The interior zone was reinforced by fittings housing two lamps placed between the normal single lamp tunnel fittings; the intermediate zone had fittings housing three lamps spaced at 1.5 metre, and the entrance zone was lit by a luminous ceiling comprised of 26 lines of medium tension lamps. There were three circuits which meant that either six, 14 or 26 lamps could be lit, according to the state of the exterior natural lighting. Inside the tunnel the general lighting by hot cathode lamps gives a level of illumination of 3 lm./ft.^{2} by day and 1.5 lm./ft.^{2} by night.

Exterior Lighting

The Thursday afternoon session was devoted to exterior lighting. Mr. Pierre Blot, teacher at the Ecole Speciale d'Architecture, speaking on floodlighting, said that the psychological and physiological success of this form of illumination was due to the fact that the object is isolated and the contrasts exaggerated. He stressed the importance of lighting which conformed as nearly as possible with the surrounding scenery. This, he said, was one of the essential factors to be remembered in public lighting. It was up to the lighting engineer to preserve the beauty of the building or monument, not to deform it; a frequent fault, he said, was exaggerated shadow effect.

He also pointed out that the floodlighting installations at Toulouse during the conference had shown that effective installations need not be costly.

Speaking on the lighting of open spaces, Mr. Armand Vallat, general secretary of the A.F.E., said that it was becoming increasingly common to light open spaces by means of long-range projectors or by special fittings placed on high supports. The progress made in these last few years in the production of light sources of high

efficiency and high light output clearly favours this trend. He said that this method enabled costs of installation and maintenance to be cut because very often several fittings were placed on the same support.

The earliest installations of this kind, he said, were carried out in the United States and later in France in 1927 by the S.N.C.F. (French National Railways) for the lighting of station marshalling yards. A comparison of results obtained over a period of months before and after the installation of lighting showed an increase of 15.5 per cent. in the number of coaches handled, a decrease of 21 per cent. in the cost of repairs and a great reduction in accidents to personnel. These advantages apply to all spaces where an equivalent output of work at night to that during the day is required, i.e., petrol refineries, coal depots, quays, etc. Mr. Vallat showed slides of a number of recent installations in France, the United States and in Great Britain.

The exterior lighting session also included two papers on lighting for aircraft, one by Mr. Baldino and the other by Mr. J. Roger. "Visual Aids to Air Navigation—Beacons and Signals," was the title of the paper given by Mr. Baldino, in which he gave a short history of the progress made in this field, describing various existing systems. He spoke on the different types of beacons used at air bases and mentioned that lighthouses might also be adapted for air navigation. He also mentioned the principal systems of approach lighting developed abroad, and outlined the arguments for and against lateral and axial lines of approach. He stressed the obvious importance of good aerodrome lighting for the safety of aerial navigation.

The Hotel de Bernuy, Toulouse.

Interior Lighting

Speaking on the practice and development of lighting in Parisian shops, Mr. B. Henri-Martin said that window and interior shop lighting was indeed important. The former attracted the passer-by and the latter, if good, helped the buyer to choose and also facilitated the work of the sales staff. It was no longer sufficient or satisfactory, he said, to light the windows by a battery of reflectors which gave plenty of uniform light; modern light sources enabled each window to be treated in much the same manner as a theatrical scene.

Although the basic lighting of windows was now by fluorescent lamps, incandescent lamps were still used. The greatest problem was to screen the light sources from the view of passers-by, and louvres in either metal or plastic were frequently used to this end. Shadow effects were obtained by the use of partially silvered incandescent lamps, or by spotlights, to highlight a particular object. In certain cases when very pronounced contrasts were required, it was sufficient to use a single projector. Colour effects, since the introduction of the fluorescent lamps, had become very important, and it was sometimes necessary to change the lamps according to the merchandise shown.

During the last few years the conception of interior shop lighting had also changed, higher levels of illumination, sometimes up to 100 lm./ft.^{2}, were now quite popular. In some installations the whole ceiling area was louvred.

Mr. Henri-Martin showed several slides of installations, illustrating how lighting engineers had collaborated with designers to utilise new lighting techniques, thus maintaining the high reputation for tasteful and original presentation that the rest of the world had come to expect from Paris shops.

Mr. Pierre Dilly then dealt with lighting in hotels, describing in detail the requirements of the various private and public rooms.

The numerous uses of lighting in agriculture were discussed by Mr. Chaumier, secretary of the French National Society for Horticulture. The introduction of electric light, he said, had greatly increased the scope of the farmer; light was used not only to increase and hasten the development of vegetables and other plants, but also had great use in the rearing of livestock.

In the town of Toulouse, said Mr. Lucien Babonneau, speaking on domestic lighting in that town, the domestic electrical consumption was relatively low, being only about 200 kw. per consumer. An experiment was carried out last December when 975 consumers living in one quarter were visited. They were all advised to have better lighting, given pamphlets and a gift of a modern opal tungsten lamp. The results of this experiment showed that the householders knew little about the principles of good lighting, and 95 per cent. of the homes visited had old-fashioned fittings, many of which were in a dilapidated condition. The availability of modern lamps was almost unknown.

Public education was very important, and it should be undertaken not only by publicity and propaganda, but also by direct action in the form of campaigns and demonstrations. The results of such campaigns would mean increased consumption, thus benefiting manufacturers, contractors, and suppliers, who should finance such schemes.

Lamps and Lighting in the United States

The Friday afternoon session was devoted to various aspects of lighting in the United States, and was opened by Mr. Gaymard, who described a recent tour of street lighting installations in the United States. The next speaker was Mr. E. W. Commery, of the G.E.C., Nela Park, Cleveland, Ohio, who spoke about the standardisation of white fluorescent lamps. He reviewed the progress and various developments made during the 10 years from 1938, when the first white fluorescent lamps were introduced in the United States, to 1948, when no fewer than six different shades of white coloured lamps were on the market. Some attempt to standardise the range of colour was obviously needed, and, in 1949, after much research, four white lamps were put on the market. They were standard cold white, special cold white, standard warm white, and special warm white. Each pair of lamps had more or less the same colour appearance when lit, but the colour rendering properties of the special lamp in each case were much better. As a result of the research made in this effort to standardise these white lamps, there is a uniformity in the range of colours now offered by manufacturers.

The next paper in this series was by Mr. M. N. Waterman, of the Westinghouse Electric Corporation, United States, who spoke on high-pressure mercury lamps and their applications in the United States. He

said that the mercury vapour lamps had developed more quickly than any other type of light source. They were used mainly for public lighting and industrial lighting, and there were at the moment about 1,000,000 of these lamps in use in the United States. He then went on to describe the characteristics of the four types of lamp in current use, i.e. the 400 w./15,000 lm., 400 w./20,000 lm., 1 kw./55,000 lm., and the 3 kw./120,000 lm.

He then demonstrated the new 400-watt mercury fluorescent colour corrected type of lamp which has an efficiency of 55 lm./watts and a light output equivalent to eight 40-watt tubular fluorescent lamps with a life of 10,000 hours. This lamp, therefore, has considerable advantages in regard to efficiency, maintenance, and the number of lighting points required in certain types of installation. Mr. Waterman said that there was a high demand for these lamps in the United States, particularly for street lighting, where one in three of new installations used these lamps. It was also proving popular for industrial lighting. It was understood that a 1-kw. lamp would be available shortly.

Mr. A. H. Manwaring, Vice-President of the Illuminating Engineering Society (New York), spoke on the work of that Society. It was, he said, formed in 1906 with the aim of advancement and propagation of theoretical and practical knowledge in the science and art of lighting. He went on to explain the functions of the Society, mentioning its publications, which included the I.E.S. Lighting Handbook. He also dealt with the research and study committees of the I.E.S.

Mr. C. A. Atherton, General Secretary of the C.I.E., then spoke on the organisations contributing to the development of lighting in the United States, which included many organisations in addition to the American National Committee and the I.E.S.

This session on lighting in the United States was wound up by Mr. Jean Chappat, who showed a number of slides of American lighting installations.

Final Session

At the last session on the Saturday morning a paper on lighting education was given by Mr. Rene Nampon. The final paper was by Mr. Henri Marty on demonstration material.

There was then an address on lighting and art by Mr. Babonneau of Toulouse University, after which the President of the Association Française des Eclairagistes, Mr. Andre Claude, brought the conference to a close.

The Association is to be congratulated on the wide variety of subjects which they most successfully covered at this conference, and also on their organisation. One of the objects of holding the meeting outside Paris was certainly achieved, as a very large number of engineers whose work is closely allied to lighting were attracted to the meeting. And no doubt the city of Toulouse will remember the visit and illuminations for a long time.

PERSONAL

Members of the I.E.S. included in the Birthday Honours List were Mr. F. C. Smith, of the North Thames Gas Board, and Mr. L. Knopp, of the Cinematograph Exhibitors' Association, whom we would congratulate on their awards of the M.B.E.

Mr. H. E. Goody, who has been manager of the B.T.H. Lamp Advertising Dept. since 1921, retires on July 31. He has been connected with the electrical industry for 53 years and was a permanent member of the E.L.M.A. Publicity Committee. We wish Mr. Goody a long and happy retirement.

Mr. C. Heydon-Brash, recently with Veritys, Ltd., has now joined C. M. Churchouse, Ltd., as a sales representative.

It is with regret that we report the death on June 6 of Mr. F. T. Milne at the early age of 46. He joined the G.E.C., Ltd., in India and moved to the head office in London, where he was one of the company's principal lighting engineers. He was a Fellow of the I.E.S.

I.E.S. REGISTER

The list of Registered Lighting Engineers (I.E.S.) just issued by the I.E.S. includes the names of over 200 members whose names are included on the Register and who have subscribed to the publication of the list.

The Production of Glass Bulbs

This article describes glass bulb production by means of ribbon machines installed in a new factory at Harworth. These machines are the only two of their kind in use outside the United States.

Up to 25 years ago the many different types of glass bulbs required by the lamp and valve industries were all made by skilled hand blowers. Since that time various automatic machines have been in use which are capable of producing bulbs in considerable quantities. However, the increasing demand both from home and overseas markets has made it necessary to undertake production on a scale never previously contemplated. Accordingly, the British Thomson-Houston Company, Ltd., and the General Electric Company, Ltd., have jointly formed a new company, Glass Bulbs, Ltd., with a factory at Harworth, near Doncaster, Yorkshire, which is capable of producing 1,500,000 glass bulbs a day. Production of all the bulbs required for "Mazda" and "Osram" general lighting service lamps is being concentrated at this factory; in addition to this, the output is sufficient to meet the requirements of all other lamp manufacturers in the British Isles and to allow an ample margin for export to Europe and the Commonwealth. This vast production has been made possible by the installation of two ribbon-type machines which are the only ones of their kind outside the United States.

The factory building is 700 ft. long by 80 ft. wide, and is laid out and equipped so as to take full advantage of the capacity of the ribbon machines. There are over 600 employees. The plant comprises the main factory building housing the furnace, ribbon machines, annealing lohrs, inspection point, packaging lines, chemical laboratory, stores, workshop and main offices. At one end is the mixing tower, where the raw materials are taken in, and it is from this point that the manufacturing process begins, terminating in the finished products which, packed in cartons, are transferred on a conveyor belt to the finished bulb stores, where they are loaded directly into railway wagons in which they travel to their destinations in this country or to the ports for shipment abroad.

The entire scheme of manufacture is based on a system of flow production, and is highly mechanised throughout.

Private sidings on the factory site, which connect with a nearby railway line, enable the raw materials to be delivered directly to the works without transhipment.

From this point all of them are raised by suction to the top of the mixing tower, with the exception of the sand which is blown up under pressure.

This tower, which is built in reinforced concrete, and rises to a height of 100 ft., merits a rather more detailed description. It is the only one of its kind at any glass works, and presented some unique problems in structural engineering. It consists essentially of seven silos, extending from the top to the bottom of the tower, each of which is capable of holding 1,500 tons. The raw materials consist of soda ash, dolomite, limestone, sand and felspar in addition to cullet, or surplus glass, which is fed to its silo by a mechanical bucket conveyor inside the building. It is worth noting that all these materials are obtained in this country: the sand from King's Lynn, in Norfolk, the soda ash from Northwich in Cheshire, the limestone from Buxton in Derbyshire and the dolomite locally from a source near Doncaster. The resultant glass contains very roughly 72 per cent. silica, 18 per cent. soda, 6 per cent. lime and 3 per cent. magnesia.

The raw materials are reclaimed mechanically from shelves at the top of their respective silos, and pass down chutes to the automatic weighing machines two floors below, whence they are discharged in their correct proportions into a rotary mixing drum.

On the floor directly below the outflow

at the top of the tower are situated the remote control panels which give an accurate and instantaneous picture of the progress of events. Coloured indicator lights show the conditions in the silos, when they are being replenished, the passage of materials into the weighing machines, their discharge into the mixing drum and so forth. Most of these operations are remotely controlled by push-buttons on the panels, so that a small staff of two men is able to supervise the working of this important section.

From the mixing drum the now thoroughly blended materials are automatically discharged into canisters, which are mechanically conveyed on a roller runway to the hopper from which the furnace is fed. The hopper discharges into the electrically operated mobile screw feeders, which force the charge, or batch, into the mouth of the furnace.

This is a continuous tank-type cross-fired regenerative furnace capable of producing 150 tons of glass a day. The furnace is fired with coke-oven gas, and the regenerative feature enables the incoming air to be pre-heated before entering the furnace, thus effecting a valuable economy in the use of fuel.

Temperatures are suitably graded through the melting and refining ends, the glass finally passing through the forehearths, which are of the most modern automatic type, and which bring the glass to the exact temperature required for feeding to the ribbon machines (Fig. 1). Pressure in the furnace is maintained automatically at slightly above atmosphere. Remote recording and metering instruments are grouped on panels in the machine-room.

The Ribbon Machine

Fig. 2 gives an idea of the complete process of bulb blowing in the ribbon machine. On leaving the forehearth a controlled stream of glowing, molten glass flows down between two rotating water-cooled rollers at one end of the ribbon machine. One roller has a plain surface, the other contains pockets, or circular depressions, so that the glass issues from between them as a continuous ribbon bearing a series of shallow circular protuberances or "humps" in appearance resembling the ribbon of "caps" used in a boy's toy pistol. On leaving the rollers the ribbon is carried on a continuous belt of orifice plates, each of which is pierced with a circular hole that comes accurately into position beneath a "hump." Moving forward on the orifice plates the ribbon now meets a continuous chain of blowheads which descend on to it from above, each blowhead pressing into the centre of a "hump" directly over a hole in each orifice plate.

A puff of compressed air issuing from the blowhead causes the "hump" to be extruded downwards through the hole in the orifice plate, the function of which is to determine the diameter of the flare at the top of the neck of the finished bulb. These embryonic bulbs, or glass blanks as they are called, hanging below the rapidly moving ribbon, increase in depth until they meet the split moulds which rise from below on a continuous belt and close round them from

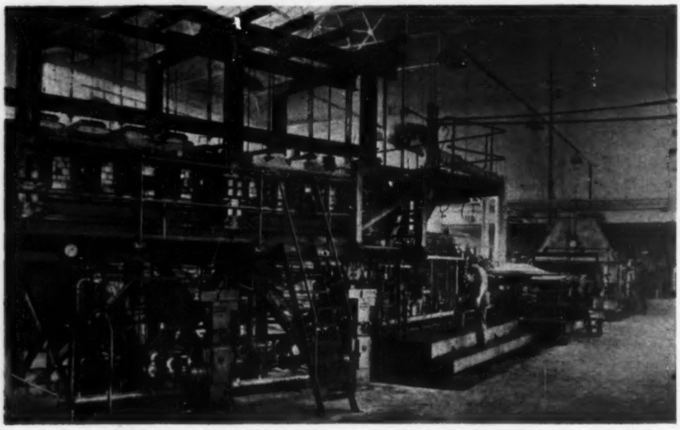


Fig. 1. Forehearth and ribbon machine.

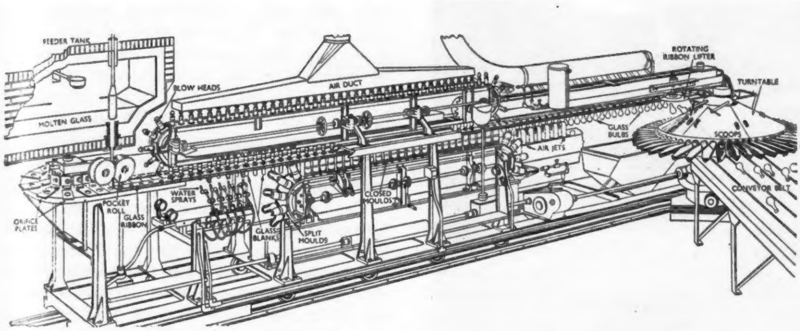


Fig. 2. Diagram of the ribbon machine in operation.

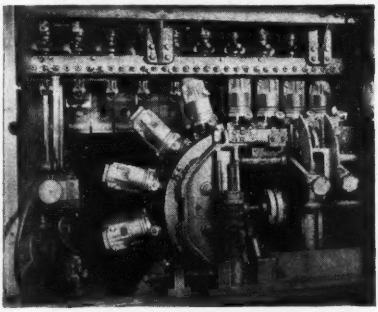


Fig. 3. Glass blanks hanging from the ribbon meeting and entering the moulds.

both sides (Fig. 3). The moulds now begin to rotate and meanwhile the air pressure from the blowheads increases so that the glass blanks are moulded to their final shape. It will be understood that during this operation the ribbon, blowheads and moulds are all moving forward together at the same speed. On completion of this process the moulds open, revealing the bulbs (Fig. 4) and return on their belt under the machine. Similarly the blowheads break contact with the glass ribbon and return along the machine on the upper side of their chain. The orifice plates, carrying the ribbon with the blown bulbs depending from beneath it, continue to travel forwards while jets of cooling air play upon the completed bulbs. On reaching the rotating ribbon lifter the bulbs are successively tapped off by the strokes of a synchronised hammer and fall into the scoops of a rotary turntable which tip them on to a moving belt for conveyance through a gas-fired lehr, or annealing oven (Figs. 5 and 6). The glass ribbon passes down to the floor below where it is water-cooled and subsequently broken up for reuse as cullet, while the orifice plates return horizontally behind the machine.

The moulding of the bulbs is essentially a very delicate and precise operation, and for this reason the moulds are cork lined. The heat of the glass transforms the cork into fine carbon, which readily absorbs water from the cooling sprays that play on the moulds as they pass back under the machine. Coming into contact with the hot glass, the water is vaporised, so that the bulbs are formed in a cushion of steam

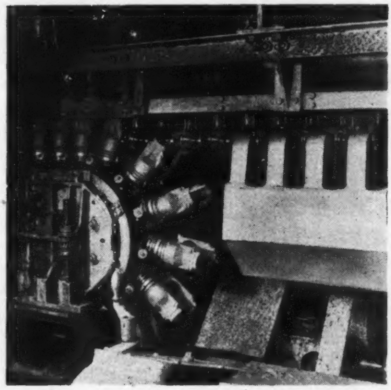


Fig. 4. Finished bulbs leaving the moulds. Jets of cooling air are seen on the right.

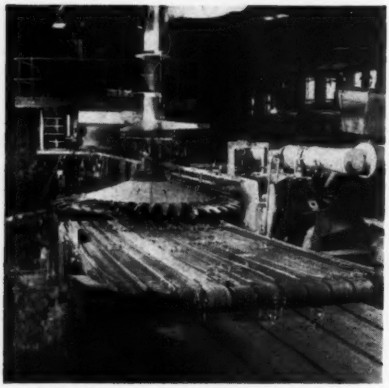


Fig. 5. Finished bulbs being discharged from the rotary turntable on to the belt conveyor.

which leaves them with a polished surface finish.

The two ribbon machines are of different sizes: the larger one has a pitch of 3.9 in. from centre to centre of the orifice plates, the smaller a pitch of 3 in. The pitch dimension naturally determines the size of bulb which can be blown. There are, in all, seven different sizes of orifice plate, and rollers of two different depths of pocket: 7-32 in. and 9-32 in. respectively.

An important characteristic of the ribbon machine is that it is much more versatile than any other bulb-blowing machine. It will blow the miniature type of valve bulb at a very high speed and can be quickly turned over to the production of large-size filament lamp bulbs. A further important feature is the consistency of the product and its constant dimensional accuracy which greatly exceeds that previously obtainable from any other machine.

The larger machine, with moulds at 3.9-in. centres, produces from 350 to 500 bulbs a minute in the 70-mm., 75-mm. and 80-mm. sizes for 75-watt, 100-watt and 150-watt general lighting service lamps. Operating on a continuous 24-hour schedule, this machine gives a daily output of approximately 500,000 bulbs. The smaller machine, in which the mould centres are at a 3-in. pitch, will produce the whole range of valve bulbs up to 44.5-mm. diameter, including all the miniature types, and lamp bulbs from the 25-mm. stop- and tail-light size up to and including the 65-mm. bulb for the 60-watt general service lamp. The output of this machine, which runs continuously throughout the 24 hours, is approximately 1,000,000 bulbs daily.

After annealing, the bulbs are air-cooled while proceeding on a conveyor belt to the packers. At the control point five bulbs are picked off the belt every 12 minutes for examination and dimensional checks, continuous inspection being carried out on a quality control basis.

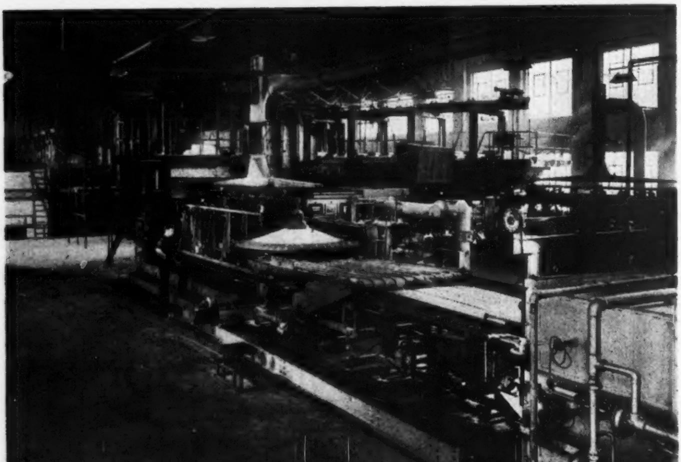


Fig. 6. The furnace, ribbon machine and entry to the annealing oven.

Correspondence

Street Lighting

To the Editor, LIGHT AND LIGHTING.

Sir,—In the March issue "Lumeritas" quotes some comments made by the coroner at a recent Oxford inquest: "It may be that if one headlight had been in use this woman would not have been killed, and that a great many similar accidents would not have occurred if there were an accepted principle that motorists should have one headlight on." Unfortunately, this "principle" is fraught with danger.

The use of dipped headlamps on roads with widely spaced street-lamps causes objects to be seen alternately by direct and by silhouette vision, depending on whether the background is a "pool of light" or a "shadow." This effect is usually unnoticed, but when it is it is disconcerting and rather startling. At some point during the transition from direct to silhouette vision, the brightness of the object (or a part of it) lit by the headlamps and of its background lit by the street lamp are the same, and the object is thus practically invisible. Specular reflections from such things as boots, or plated cycle parts, as well as the movement of the object, usually betray its presence; but this is not always so, and occasionally the relative movement of car and obstruction will dangerously prolong the period of invisibility.

An investigation that I made recently showed that for one brightness patch there may be a number of positions where a large object is invisible in practical driving conditions. One significant effect noticed was that the object (a man) could often not be found for a period of some seconds by an observer who was unaware of its position, although once found it appeared reasonably distinct. This seemed to be at least partly due to the observer assuming that the object was "lost in shadow" and not "lost in light," and thus searching the darker areas first.

Fig. 1

Fig. 2

It appears from this that the use of headlamps on poorly lit roads sets a dangerous trap for the motorist for he, like the Oxford coroner, is entitled, in the name of common sense, to assume that using his headlights will render objects more visible all along the road, not more visible in most places and invisible in some; certainly not invisible in the brighter parts of the road.

The I.E.S. of South Australia regards this

matter seriously, and has recently used a model street to demonstrate the effect to lighting authorities with considerable effect. Two photographs of this model are enclosed. Fig. 1 shows the pedestrian in silhouette; in Fig. 2 the light from a headlight has practically obliterated the brightness contrast between him and the bright road surface.

It seems probable that this effect is responsible for many accidents of the "he seemed to appear from nowhere, right under my wheels," type. The police evidence sometimes given in such cases that visibility was reasonably good *even* without headlights, means, in fact, that it was good *if* no headlights were used.—Yours, etc.,

S. D. LAY.

South Australia.

Testing of Fittings

To the Editor, LIGHT AND LIGHTING.

Sir,—At a recent I.E.S. Sessional Meeting Messrs. Bloxsidge, Fahey and Waigh presented an interesting and comprehensive paper entitled "The Specification and Testing of Fluorescent Lighting Fittings and their Components." However, a 1 kv proof test is surely far too low for present-day requirements. It should be at least 2 kv for one minute. It may be their submission that high-voltage tests permanently weaken insulation. As one of the small band who first advanced this contention 30 years ago may I emphasise that it was never intended to apply to low-voltage proof tests but to the continued series of over-voltage tests on EHT insulators then common practice.

It was by no means uncommon for EHT switchgear insulators to be subjected to 2½ times between-phase service voltage plus 2 kv—that is 94 kv on a 33-kv insulator—on five occasions; once by the insulator maker, on acceptance by the switch maker, on assembly in the switchboard, on completion of the switch assembly and, finally, after erection. In service it had to stand only 19 kv to earth.

There was a real justification for the contention that such methods imposed serious overstrain on insulation which went into service with a reduced factor of safety. A term, "fatigue," was coined which was expressed as the "rate of change of factor of safety."

This is very different from a 2 kv one-minute proof test on low-voltage insulation. A single 15-mil thickness of Empire Cloth will stand a one-minute test of 15 kv. We would have agreed that 5 kv to earth for one minute would not have been excessive for a single proof test on 230-volt gear. 2 kv is the absolute minimum.

The great danger to the exceptionally low voltage test is the wide adoption of materials as insulation which are totally inadequate for normal supply voltages. For example, wood-flour-filled phenolic moulding, widely used for terminal blocks on similar occasions, is, by reason of "tracking" weakness, entirely unsuitable. There are special electrical grade phenolics and a high-voltage acceptance test would eliminate non-electrical grades from production. I think the E.R.A. would agree on this point.

Insulation resistance in itself has little merit. It tells nothing unless checked against tests taken at different times on the same component. One can have high insulation resistance with low voltage breakdown and vice versa. Low insulation resistance may be indicative of a general low standard of insulation or a localised area of poor insulation in an otherwise excellent insulating system. By itself it tells nothing and has no place in a purchasing specification.

No reference has been made to a specification standard for capacitors. This is an important omission. The vital component of a capacitor is a large sheet of insulating material—usually thin impregnated paper—the dielectric strength of which is only as great as its weakest point. A single-paper dielectric is clearly not to be recommended. Two-paper dielectrics have a doubled factor of safety but a pinhole in one sheet—by no means uncommon—halves it. A three-paper dielectric is preferable. Since capacity is inversely proportional to dielectric thickness we are faced with dimensional limitations and two-paper dielectrics may have to be accepted. They are vulnerable as fault producers and should, therefore, be self-isolating. This opinion is shared by leading capacitor manufacturers, many of whom include a fuse within the container.

The authors are surely at fault in relating colour to ballast design in table 1. Granted the output of blue rays from the mercury arc is dependent to some extent upon current, the effect is only of a degree covered by the footnote to the table. Similarly, while starting may be dependent upon ballast design in conventional starter switch circuits, this is surely not the case with "quickstart" circuits.—Yours, etc.,

Thames Ditton. LIONEL G. HILL.

Lighting in a Public Park

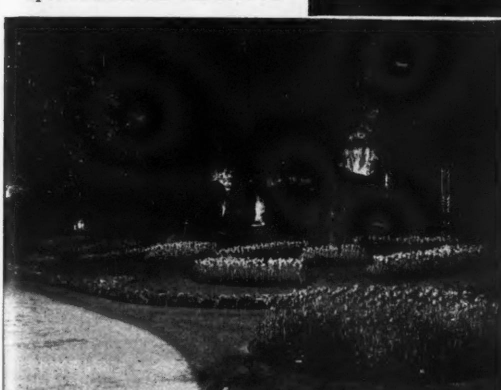
The I.E.S. President recently made an appeal for more floodlighting in parks and gardens. The following is a brief description of lighting in a Nottingham park.

The principal attraction of last month's celebrations commemorating the centenary of the Arboretum, Nottingham's premier public park, was the night-time illumination of lakes, flower-beds, trees and other ornamental features. The planning of the lighting and its installation were in the hands of Farrow and Pickford, Ltd., Nottingham, who made extensive use of G.E.C. lighting equipment and Osram lamps to implement a scheme which, while picking out the natural beauty of particular features in the Arboretum, never loses sight of the necessity for continuity and harmony in the whole panorama.

The 18-acre park, opened in May, 1852, is well sited near the centre of the city. The beauty of flower gardens, shrubs and tree-lined avenues has grown with the passage of time.

Special attention was devoted to the ornamental lake, the multi-jet fountain being illuminated by eight 500-watt submerged floodlights with four colour changes operated by motor-driven dimmers. The decorative effect was enhanced by reflections in the lake's still water of illuminated trees and shrubs. A bridge connecting two islands was treated with louvred spotlights which emphasised its rustic character.

The lofty trees surrounding the park were floodlit by a mixture of tungsten and discharge lamps, strategically sited out of sight of the majority of spectators.



Two views of the Nottingham Arboretum, showing the pagoda and some of the flower-beds.

I.E.S. ACTIVITIES

Leeds Centre

Mr. J. Sewell was in the chair at the Annual General Meeting of the Leeds Centre.

During the proceedings the Hon. Secretary, Mr. R. D. Green, presented the Annual Report of the Leeds Centre on behalf of the Leeds Centre Committee. The Hon. Treasurer, Mr. H. Edmondson, followed with his report and statement of the accounts for the year ending December 31, 1951. An appeal was made to the membership by the Chairman for higher attendances at sessional meetings.

The Centre was honoured by the presence of Mr. E. C. Lennox, a Vice-President of the Society, who accepted an invitation at very short notice to be present at the meeting and to address the members. In his address Mr. Lennox discussed the aims and objects of the Society, and referred to the pioneers who had helped so much in the early days. The Vice-President attached considerable importance to the student membership of the Society whom he felt should be encouraged in every way possible.

In conclusion, a film was shown, covering the manufacture and application of modern electric light sources.

Liverpool Centre

Quite a good attendance greeted Mr. L. C. Rettig, F.I.E.S., when he delivered his paper, "Lighting and Safety in Factories," on Tuesday evening, May 6, 1952, to the Liverpool Centre.

In opening his paper, Mr. Rettig stated that conditions liable to cause personal injury were more or less constant in most types of factories, causing losses both in production and man hours. These losses cause considerable alarm to all concerned.

In reviewing the heavy industries, it was found that the lighting standards were, on the average, poor as compared with modern types of factories.

Reference was made to the minimum illuminations required under the Factories Act, and those present were given a practical demonstration of the different levels required through the reduction of the general auditorium lighting to the various prescribed

I.E.S. members and guests, including the President, Mr. J. G. Holmes, at the recent Nottingham Centre Ladies' Evening.

standards. Coupled with this demonstration was a further demonstration to show the difficulties of distinguishing articles or figures of small relative contrast under these conditions. Mr. Rettig also made reference to basic conditions regarding quality of the lighting, mounting heights of the various types of units, angles of cut-off, etc., as laid down in the Factories Act.

The next point discussed was that of disability glare and its possible dangers to workers. The speaker showed that, even from a source of less than 10 candles per sq. inch, disability glare can be of considerable trouble.

Nottingham Centre

The last meeting of the Nottingham Centre for the present session was held on April 3, when Mr. E. J. G. Beeson of the B.T.H. Research Laboratory spoke on the subject of ' Artificial Lighting for Cinema Studios." He explained how the development of new light sources, such as the high-pressure mercury cadmium compact-source and xenon discharge lamp has given, during the past few years, a new stimulus to the lighting of film studios. Not only are new light sources being developed, but new developments are continually taking place in photographic materials which make even greater demands on the spectral composition of the light source.

The most widely used form of illuminant has been the carbon arc, taking currents of up to 300 amps, and the incandescent lamp in ratings of up to 5,000 watts. The compact-source lamp in the colour-modified form has been successfully applied to the taking of colour films, and lamps of 2½ kw. and 5 kw. are in use in various studios. Some 10 kw. lamps have also been used experimentally. These high-pressure enclosed arcs in metal vapours and rare gases have important advantages over the carbon arc; the electrodes are not consumable and do not give off smoke or fumes, and the arc is also silent. Another advantage is that the arc is very stable, and it remains in focus requiring little or no attention while running. The problem in the delay in reaching full light output and restarting the arc under all conditions of temperature and pressure has largely been overcome. These lamps provide a highly efficient source of light and compare very favourably with the high-intensity carbon arc.

Recently in America a new colour film has been undergoing trials which requires only about one-third the lighting intensity at present used for colour productions. It is, therefore, possible that there may be a change back from carbon arc lamps and even high-pressure mercury vapour lamps to tungsten sources for colour-film production; nevertheless the new light sources can play an important part in easing the problems of the lighting cameraman in his constant search for new ideals.

Sheffield Centre

On April 21, the Sheffield Centre members were honoured by a visit from the I.E.S. president, Mr. J. G. Holmes, who gave a lecture entitled "Natural Lighting," using mainly the subject matter of his Presidential Address. The lecture proved very stimulating, provoking an interesting discussion, which was opened by Mr. H. B. Leighton, A.R.I.B.A., who spoke of the necessity for close collaboration between lighting engineers and architects.

A number of other speakers followed, including Professor Stephen Welsh, Professor of Architecture, and Professor H. Moore, of the Department of Glass Technology, both of Sheffield University, who raised points of interest.

I.E.S. ACTIVITIES

Leeds Centre

Mr. J. Sewell was in the chair at the Annual General Meeting of the Leeds Centre.

During the proceedings the Hon. Secretary, Mr. R. D. Green, presented the Annual Report of the Leeds Centre on behalf of the Leeds Centre Committee. The Hon. Treasurer, Mr. H. Edmondson, followed with his report and statement of the accounts for the year ending December 31, 1951. An appeal was made to the membership by the Chairman for higher attendances at sessional meetings.

The Centre was honoured by the presence of Mr. E. C. Lennox, a Vice-President of the Society, who accepted an invitation at very short notice to be present at the meeting and to address the members. In his address Mr. Lennox discussed the aims and objects of the Society, and referred to the pioneers who had helped so much in the early days. The Vice-President attached considerable importance to the student membership of the Society whom he felt should be encouraged in every way possible.

In conclusion, a film was shown, covering the manufacture and application of modern electric light sources.

Liverpool Centre

Quite a good attendance greeted Mr. L. C. Rettig, F.I.E.S., when he delivered his paper, "Lighting and Safety in Factories," on Tuesday evening, May 6, 1952, to the Liverpool Centre.

In opening his paper, Mr. Rettig stated that conditions liable to cause personal injury were more or less constant in most types of factories, causing losses both in production and man hours. These losses cause considerable alarm to all concerned.

In reviewing the heavy industries, it was found that the lighting standards were, on the average, poor as compared with modern types of factories.

Reference was made to the minimum illuminations required under the Factories Act, and those present were given a practical demonstration of the different levels required through the reduction of the general auditorium lighting to the various prescribed

I.E.S. members and guests, including the President, Mr. J. G. Holmes, at the recent Nottingham Centre Ladies' Evening.

standards. Coupled with this demonstration was a further demonstration to show the difficulties of distinguishing articles or figures of small relative contrast under these conditions. Mr. Rettig also made reference to basic conditions regarding quality of the lighting, mounting heights of the various types of units, angles of cut-off, etc., as laid down in the Factories Act.

The next point discussed was that of disability glare and its possible dangers to workers. The speaker showed that, even from a source of less than 10 candles per sq. inch, disability glare can be of considerable trouble.

Nottingham Centre

The last meeting of the Nottingham Centre for the present session was held on April 3, when Mr. E. J. G. Beeson of the B.T.H. Research Laboratory spoke on the subject of "Artificial Lighting for Cinema Studios." He explained how the development of new light sources, such as the high-pressure mercury cadmium compact-source and xenon discharge lamp has given, during the past few years, a new stimulus to the lighting of film studios. Not only are new light sources being developed, but new developments are continually taking place in photographic materials which make even greater demands on the spectral composition of the light source.

The most widely used form of illuminant has been the carbon arc, taking currents of up to 300 amps, and the incandescent lamp in ratings of up to 5,000 watts. The compact-source lamp in the colour-modified form has been successfully applied to the taking of colour films, and lamps of 2½ kw. and 5 kw. are in use in various studios. Some 10 kw. lamps have also been used experimentally. These high-pressure enclosed arcs in metal vapours and rare gases have important advantages over the carbon arc; the electrodes are not consumable and do not give off smoke or fumes, and the arc is also silent. Another advantage is that the arc is very stable, and it remains in focus requiring little or no attention while running. The problem in the delay in reaching full light output and restarting the arc under all conditions of temperature and pressure has largely been overcome. These lamps provide a highly efficient source of light and compare very favourably with the high-intensity carbon arc.

Recently in America a new colour film has been undergoing trials which requires only about one-third the lighting intensity at present used for colour productions. It is, therefore, possible that there may be a change back from carbon arc lamps and even high-pressure mercury vapour lamps to tungsten sources for colour-film production; nevertheless the new light sources can play an important part in easing the problems of the lighting cameraman in his constant search for new ideals.

Sheffield Centre

On April 21, the Sheffield Centre members were honoured by a visit from the I.E.S. president, Mr. J. G. Holmes, who gave a lecture entitled "Natural Lighting," using mainly the subject matter of his Presidential Address. The lecture proved very stimulating, provoking an interesting discussion, which was opened by Mr. H. B. Leighton, A.R.I.B.A., who spoke of the necessity for close collaboration between lighting engineers and architects.

A number of other speakers followed, including Professor Stephen Welsh, Professor of Architecture, and Professor H. Moore, of the Department of Glass Technology, both of Sheffield University, who raised points of interest.

POSTSCRIPT

By "Lumeritas"

A correspondent has drawn my attention to the fact that in one book on lighting, published in 1951, the term "candela" is used, while in another, of similar date, the author uses the old term candle when referring to luminous intensity and in defining the lumen. He inquires whether "candela" should be changed to "candle" in the definition of a lumen given on p. 451 of W. R. Stevens's "Principles of Lighting": the answer is no. The term "candela" was adopted in 1948, and it is a pity it is not used consistently in books published three years later. As to the lumen—the unit of luminous flux—it has been suggested that this unit should be rationalised to make it conform with the corresponding rationalised units of electric and magnetic flux. This would mean defining the lumen as the total flux emitted by a uniform point source of one candela instead of as the flux emitted by such a source in unit solid angle. Thus the present value of the lumen would be multiplied by 12.56 (4π). Such a change would make modern recommended values of illumination *numerically* similar to those of 40 years ago!

It is interesting to recall how low were the values of illumination recommended rather less than 40 years ago (1915) as legal minima in factories. For instance, 0.25 lumens per square foot (measured at floor level) was the statutory minimum recommended for the "working areas" of workrooms by the original Departmental Committee on Lighting in Factories and Workshops.

Another correspondent refers to my note last month on office lighting, and asks what was the nature of the work being done by the clerks who were observed to be working with 1 to 3 lm./ft.^{2}, and whether the reason for their choice was that they had tungsten lighting which they preferred to 20 lm./ft.^{2} by fluorescent lighting. The clerks concerned were calculating machine operators whose "copy" consisted of pencilled figures. Some of them had a tungsten desk lamp which was not always used, but the values I mentioned were due to light from distant fluorescent lamps—they had switched off the fluorescent lamps above their own desks.

Now that floodlighting is once again lending enchantment by night to some of London's notable buildings, nightly bus tours are being run by London Transport for those who want to see all there is to see without becoming footsore. The tours start from Northumberland-avenue at frequent intervals from 10 p.m. The distance covered is about nine miles, the time taken is about 45 minutes and the fare is 2s. The floodlit buildings to be seen include the Horse Guards, Big Ben, St. Margaret's church and Westminster Abbey, the Tate Gallery, Nelson's Column, the National Gallery, Somerset House, St. Bride's Church in Fleet-street, and St. Paul's Cathedral.

The 1952 summer issue of "The Times Science Review" contains several articles which those whose interest in light and lighting is broad may like to read. One of these articles is by the Astronomer Royal, Sir Harold Spencer Jones, F.R.S., who was the principal guest of the I.E.S. at the Annual Dinner recently held in Eastbourne. Another article, which is by Emeritus Professor Walter Stiles, F.R.S., discusses the mechanism of photo-synthesis. Of more direct interest to those concerned with lighting is an article by Dr. J. A. Gardner on recent progress in silicon chemistry. Referring to electric lamps, Dr. Gardner says:

"Ethyl silicate also has important applications in the electric lighting industry. In the manufacture of fluorescent tubes it has been found difficult to obtain satisfactory adhesion of the fluorescent material to glass. By the application of ethyl silicate a thin film of silica is deposited which on drying gives an excellent bond between the pigment and the glass. It has also been found that combustion of ethyl silicate yields silica in an adherent and extremely finely divided form, which is now being used as an internal coating for electric bulbs. Such bulbs produce less glare and give softer, more diffuse light compared with untreated bulbs, and the coatings reduce output only slightly."

In the article from which I have quoted above I noticed the use of the word "flammability" instead of "inflammability." This syllable-saving contraction is accepted in technical literature, and I have often wondered why we lighting people do not follow suit by contracting "illumination" to "lumination." The author of a recent book on vision and lighting ventured further in a footnote containing the suggestion that the rational technical term would be "lumenation."

952

ort
to
urs
re-
ace
n is
he
he
t's
ate
nal
rch

hes
les
nt-
ese
Sir
he
ual
her
sor
an-
ect
ng
ent
to

ca-
he
en
on
he
of
an
he
us-
an
m.
nal
lbs
ore
bs.
y."

ed
ord
y."
ted
en
not
to
ok
a
he
en-